Distinctiveness of Asian Driver and Western Garment Technologies in Uganda

Thesis

UNRESTRICTED

DISTINCTIVENESS OF ASIAN DRIVER AND WESTERN GARMENT TECHNOLOGIES IN UGANDA

Thesis submitted for the degree of Doctor of Philosophy
Development Policy and Practice
The Open University

BOTCHIE DAVID

BSc (Hons) (Agric Economics) and MPhil (Agribusiness)

MAY, 2015

DATE OF SUBMISSION: 17 SEPTEMBER 2014
DATE OF AWARD: 12 JUNE 2015

ABSTRACT

Over the past centuries, hard and soft technology transfer to developing countries had largely emanated from Western economies. It has been argued that these Western made hard and soft technologies are capital and skills intensive, rely on high-quality and pervasive infrastructure, and produce products for high-income consumers. Meanwhile, developing countries over the last two to three decades have witnessed a growing influx of hard and soft technologies from China and India (Asian Driver, AD, economies). The debate is that AD technologies are appropriate for the operating conditions in developing countries. This is because they are assumed to be labour intensive, tolerant to weak infrastructure, low cost, operate on small scale basis, accessible and less skills intensive. In order to validate (or otherwise) these assumptions, this research examines the distinctiveness and profitability of AD and Western hard and soft technologies using garment making machines in Uganda as a case study. I build this research on five key economic theories—the concept of hard and soft technology, technical choice, appropriate technology, technical change, the rise of the Asian drivers, technology transfer and diffusion.

The study shows five important findings (I) Uganda's landlocked nature makes the cost of transferring technologies into the country more expensive than for the country's maritime neighbours—Kenya and Tanzania; (II) relative to the Western machines, the distribution of the AD garment making machines is wider in Uganda. This spread is a function of access to finance, information and the location of the machine operator; (III) the assumption that the AD technologies are tolerant to weak infrastructure, low cost, was validated; but contrary to my expectation, the frequent breakdown of the AD garment making machines makes them relatively skills intensive; (IV) relative to the Western garment making machines, the level of profitability of the AD machines is higher in rural areas but lower in urban areas. Thus, the wider spread of the AD garment making machines does not necessarily reflect their level of profitability; (V) relative to other Western made machines, the use of manual AD garment making

machines is appropriate for increasing output, creating jobs and small scale enterprises at a minimum cost. China and India are respectively becoming the main sources of hard and soft technologies.

ACKNOWLEDGEMENT

I am most grateful to the almighty God for life and all the blessings. This dissertation would not have been possible without the studentship I received from The Open University. Hence, I will always be appreciative. I cannot express enough thanks to my supervisors, Professor Raphael Kaplinsky and Dr. Rebecca Hanlin for their invaluable advice. Second, I offer my sincere appreciation to the staff and associates of DPP especially Professor Hazel Johnson, Dr. Helen Yanacopulos, Dr. Julius Mugwagwa, Dr. Benjamin Lambert, Dr. Sally Hartley, Dr. Elvin Nyukuri, Dr. Geoff Banda, and Dr. Vuyo Njimba for the interesting conversation we had about my research work.

Thirdly, my sincere thanks go to Dr. Isaac Shinyekwa and all other staff of the Economic Policy Research Centre, University of Makerere-Uganda for the support they gave me when I was collecting data for this research in Uganda. I am really indebted to them. I am also thankful to Miss Diana Kakwera of the Ministry of Trade, Industry and Cooperatives Uganda, and Mr Richard Mubiru of the Textile Manufacturers Association of Uganda for their advice on the state of the Ugandan garment and textiles sector.

My completion of this research could not have been accomplished without the support of my colleague students, Andrew Agyei-Holmes, Richmond Atta-Ankomah, Craig Walker, and Helen Vannier for their enormous help.

My appreciation also goes to my parents for the constant support; and my siblings—Fred, Ralph, Mike, and Abigail, for constantly checking on my family in my absence. Finally, to my caring, loving and supportive wife, Dorothy: my deepest gratitude. Your encouragement in difficult times is much appreciated and duly noted. It was a great comfort and relief to know that you were willing to provide management of our household activities while I complete my thesis. My heartfelt love and thanks to you. You deserve a trip to Disney!!! Merci!!

DEDICATION

To my wife Dorothy and children Caleb and Kelvin; this is the fruit of your sacrifice.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ADs	Asian Drivers
ADSM	Asian Driver Sewing Machines
AGOA	African Growth and Opportunity Act
AT	Appropriate Technology
ATC	Agreement on Textiles and Clothing
CBR	Cost Benefit Analysis
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EPA	Economic Partnership Agreement
EU	European Union
FAO	Food and Agricultural Organisation
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GoU	Government of Uganda
IDE-JETRO	Institute of Development Economics-Japanese External Trade Organisation
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
ISI	Import-Substitution Industrialization
MDAs	Ministries, Department and Agencies
MDG	Millennium Development Goals
MFA	Multifibre Agreement
NPV	Net Present Value
NTMP	National Transport Master Plan
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
TNC	Transnational Cooperation
UIA	Uganda Investment Authority

UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organisation
UNEA	United Nations for Economic Affairs
USAID	United States Agency for International Development
WDI	World Development Indicators
WITS	World Integrated Trade Solution
WEO	World Economic Outlook
WSMs	Western Sewing Machines
WTO	World Trade Organisation

CHAPTER 1 : INTRODUCTION

"The debate about whether Asia will once again dominate the global economy — as it did for two millennia before the industrial revolution in 18th - century Britain and the rise of the US — is over. The 21st century will be the age of Asia's return to economic pre – eminence".

Victor Mallet, Financial Times, *2008*

"Improving the lives of billions of people at the bottom of the economic pyramid is a noble endeavour. It can also be a lucrative one".

Prahalad and Hammond, 2002

1.0 Background

Doing my PhD research in Uganda gave me the opportunity to travel to some of the remotest parts of the country. I remember travelling to Kasese, a district in Western Uganda bordering the Rwenzori Mountains, and its surrounding villages to interview some garment producers and retailers of garment making machines with my research assistant. In the course of the journey, my research assistant suggested that we may not get the required number of retailers for a meaningful research sample size given the limited diversity of commercial activities in that area. I started becoming apprehensive and contemplated turning back to Kampala, since the journey now seemed futile and a waste of time and resources. However, since we had already paid the full transport fare and were already halfway through the journey, we decided to continue. Our bus arrived at a Lorry Park in Kasese at around noon and we asked the driver to book us on the next bus back to Kampala. We decided to have lunch in Kasese town before getting on the bus. While looking for a place to have lunch, we were astonished to see Chinese and Indian immigrants at the helm of several retail outlets selling items ranging from needles, sewing machines to motorbikes. This was a huge relief for me. At lunch, I had a discussion with my assistant about how this presence of Asian immigrants and their products was beneficial or detrimental to the people of Kasese and its environs. Using himself as an example, he went ahead to explain to me the irresistible allure of products from China and India.

They are affordable even for the very poor; they typically cost less than any other similar

product (including Ugandan- made ones). He revealed to me that almost everything he owned was made in China or some other Asian country. This prompted me to do a self-scrutiny which made me realise that my situation was not different from his; I was using a made in China laptop and mobile phone, while wearing a made in China shirt and trousers, a made in China pair of shoes and an Indian made belt. As an economist, his reservation was that the growing presence of China and India's economic activities in Uganda is putting pressure on the local manufacturing sector and raising the cost of doing business in the country, meaning the local businesses could not compete.

In this thesis I will refer to the two economies of China and India as the Asian Driver economies, the ADs, drawing on the school of Asian Driver literature (see the Special Issue of *World Development* on Impact of Asian Drivers on the South, Volume 36, No. 2, 2008, available on www.asiandrivers.open.ac.uk/, and Kaplinsky and Messner, 2008). Specifically, Asian Driver economies – as I will go on to demonstrate – are impacting Africa not just in terms of their economic weight at a macro level but also because of the technologies (physical products and new processes) and human resource capabilities or skills that they bring to African economies.

The influence of Asian Driver economies on countries like Uganda is based on a history of interconnections between the economies of India and China with African economies, despite the recent re-emergence of the issues in recent years alongside the advent of the term 'Asian Drivers'. Specifically, the arrival of migrants from India into Uganda is not new. As I outline later (see page 43) these migrants – many of which are now naturalised Ugandan-Asians – have been integrated into the economy and society of Uganda over the last 100 years. For this reason, this present study, while recognising their influence generally on society and the economy in Uganda, does not focus on

Ugandan-Asians per se. Instead, it is interested in the influx of migrant entrepreneurs from India and China as part of the recent resurgence of interest in Africa by the so-called 'Asian Driver economies'; specifically, their influence on the development of technological capabilities in Uganda's garment industry. Therefore, whenever I refer to "Indians" in Uganda, I mean Indian citizens who have entered Uganda in recent years and who are working in the garments industry.

As in most African countries, it is not unusual to find AD immigrants in retail businesses (Lambert and Mohan, 2014), but finding them in villages in Kasese district, close to and on the slopes of the Rwenzori Mountains, where even electricity and piped water are not available was new to me. What further amazed me was the extent to which these AD immigrants had assimilated themselves into the communities and were comfortably transacting their business as if they were indigenes of the villages. Even I, though African, was always having a foreign feel in the country, but the AD immigrants were so at home in these villages. I was awestruck by what these developments say about the growing presence of the AD economies in the country. For my seven months stay in Uganda, my assistant and I kept pondering over the implications of the AD's presence on distribution and poverty reduction in Uganda. However, one important point my assistant kept making when we were thinking about the role of the AD economies in poverty reduction was their potential to contribute to infrastructure development and provision of capital equipment for the collapsing manufacturing sector in the country. The next section provides an academic introduction to these issues, particularly, the potential of the AD economies in distribution and inclusive growth in Uganda.

1.1 Research context

This section sets the scene for the research by first providing an overview of the Ugandan economy; with emphasis on low production capacity as a result of lack of technological progress. This is followed by a discussion on whether AD hard and soft technologies are likely to meet the developmental needs of producers in Uganda. The definition of technology is often associated with a hard or physical artefact but is in fact a set of techniques which include knowledge and skills necessary for a firm to use an application. As such, it is possible to define technology as either 'hard' or 'soft' (Shoffner *et al.* 2000; Mokyr, 2003; Jin, 2005). I define hard technology as the tangible physical artefact (often referred to in the literature as "embodied technology") (Stewart, 1982). "Soft" technology on the other hand is a combination of skills, knowledge and organisational competence required to make a hard technology operate efficiently (often referred to as "disembodied technology" in the literature) (Stewart, 1982). I will discuss this in more detail in Chapter 2. These discussions are done in the context of distribution and inclusive growth.

1.1.1 Overview of the Ugandan economy and its low capacity in technology

Until the 1970s, Uganda had a stable political environment and a fast growing economy with agriculture as the mainstay of the economy. Cotton was the main export crop (USAID, 2003). However, the economic mismanagement and civil conflicts that the country experienced during Amin (1971-1979), and the first (1966-1971) and second Obote (1980-1985) regimes eroded the economic successes that the country achieved before the 1970s (Moncrieffe, 2004). It started when Obote decided to nationalise all major enterprises in the country in 1970 (Mutibwa, 1992, and Bigsten, 2000). This was worsened by Idi Amin's expulsion of the Asians and other foreign nationals in the country (Bigsten, 2000). The Asians left the country with their capital and technological know-how, and thus obstructed the country's technological progress considering the fact that the local Ugandans at that time had little exposure to technologies and so could not use the technologies that were left behind (Bigsten, 2000). The industrial sector was one of the hardest hit (Collier, 1999). The sector shrunk from 14 % of GDP at the time that Amin took over in 1971 to four per cent at the end of the 1970s (Bigsten, 2000). This was reflected in the decline in growth of the economy, which lasted for almost two decades (1970s-1980s) (Moncrieffe, 2004).

However, upon assumption of office in 1986, the National Resistance Movement led by Yoweri Museveni focused on restoring economic growth and rebuilding the country's deteriorated infrastructure (IMF, 2010, and GoU, 2010). As a result, the economy started showing signs of restoration with average GDP growth of 6.5 % between 1987 and 1996, translating into a per capita growth of 3.4 % (IMF, 2010). By 2008, Uganda's economy was growing at an average of 8 %. According to the IMF country report for 2010, Uganda's impressive economic growth has contributed to a significant decline in the levels of poverty in the country. Accordingly, Uganda is on track to achieve target 1 of Millennium Development Goal (MDG) 1 which aims at halving the proportion of people who earn less than one dollar a day by 2015 (IMF, 2010). Despite the significant achievement in poverty reduction, level of inequality and unemployment rate in Uganda keeps on rising. The country experienced a rising Gini coefficient of 0.347 in 1997/98 to 0.426 in 2009/10 (GoU, 2010). Unemployment rate also increased from 3.0 % in 2007 to 4.18 % in 2010 (GoU, 2010).

This is coupled with the fact that Uganda has one of the fastest and youngest growing populations on the African continent and, thus, faces the associated challenge of providing sustainable jobs for its youthful population (AEO, 2012). Youth unemployment was estimated at 4.3 %—higher than the continent's average youth unemployment rate of 3.8 % (GoU, 2012). Furthermore, annual labour force growth rate in Uganda was 4.7 % in 2010 (GoU, 2012). Uganda has an estimated population of 30.7 million of which 50 % are aged below 15 years with slightly more females than males (GoU, 2012).

The country is landlocked with 85 % of the total population living in rural areas. Furthermore, 85 % of the population in the rural areas relies directly on subsistence agriculture for their livelihoods (Bremner and Zuehlke, 2009, and GoU, 2012). However, the remaining 15 % of the population who are located in the cities and urban areas host 90 % of the country's industrial and service firms (IFPRI, 2011). Thus, relative to the labour force in rural areas, those in urban areas have access to high income earning jobs (IFPRI, 2011). The resultant effect is the increasing inequality in the economy (GoU, 2012). This is one of the reasons why the Uganda Industrial Policy recommended a shift of the excess labour in the agricultural sector to the industrial sector so as to create sustainable jobs, increase value addition and ultimately reduce inequality and poverty (GoU, 2008).

However, lack of technological progress has been identified as one of the main issues contributing to the rising inequality and unemployment rate in the country (GoU, 2011). In spite of official statements on the relevance of technology for industrial growth, efforts are yet to take into account the specific technological needs of the industrial sector (UNCTAD, 2003, and 2013). Most of the expressed intentions on technology promotion have not been translated into concrete policy measures, and implementation too has generally lagged (UNCTAD, 2003, and 2013). Again, there is a shortage of skilled personnel, especially in technical and management skills. The resultant effect is a continued decline in the manufacturing sector (see Chapter 4 for details).

This situation has been worsened by the lack of infrastructure such as roads and energy which are necessary to support the transfer and use of technology (UNCTAD, 2003, GoU, 2011). Uganda's current infrastructure gap is impeding faster growth of the economy (Ranganathan and Foster, 2012). For instance, between the 1990s and early 2000s, infrastructure improvements in Uganda contributed a paltry 1.5 % to the country's per capita growth rate (Ranganathan and Foster, 2012). The Global Competitiveness Report 2012-2013 also indicated that the country ranked poorly on the quality of electricity supply and transport infrastructure in 2012 (World Bank, 2013). The World Bank's Enterprise Survey also estimated that the country's infrastructure deficit accounted for 58 % of low firm productivity in 2006 (World Bank, 2006).

Thus, Uganda as a landlocked country, coupled with its rising inequality and unemployment, amidst a fast growing population, largely caused by limited technological progress in a weak infrastructural environment presents an appropriate case to examine the type of technologies that may be appropriate for the economy. In doing so the study uses garment and textile technologies as a case study. I will discuss the pro-poorness of AD and Western garment making technologies in Uganda (Section 1.1.2) and in more detail in Chapter 6 of this thesis, but first I discuss the importance of the garment and textile sector to the Ugandan economy.

The country recognises the garment and textiles sector as one of the strategic areas of economic growth and social transformation. The sector is labour intensive in many links in the value chain and so has great developmental spin-offs for developing countries like Uganda (Gereffi and Frederick, 2010). The Ugandan National Textiles Policy indicates that the garment and textiles value chain supports the livelihood of about 400,000 households (GoU, 2009). Thus its importance for job creation and poverty reduction cannot be overemphasised. Again, not only is the sector one of the easiest points of entry to a broad range of SMEs but, if managed well, it has the capacity to unleash growth and competitiveness for Uganda's manufacturing sector (GoU, 2009).

Insofar as the study focuses on manufacturing, international experience shows that the garment sector is a key leading sector for industrial development in low income countries (McNamara, 2008, and Gereffi and Frederick, 2010). Though evidence above has shown that the sub-sector supports the livelihoods of many households in Uganda, there is more room for improvement. Production is far below capacity (GoU, 2009). The Uganda National Textile Policy attributes this largely to lack of technological capacity and its related supportive infrastructure, as well as absence of trained technical workforce (GoU, 2009). This is against the backdrop that the country's progress in technology and innovation is on the decline (Ramanathan, 2009). Accordingly, Uganda's ability to adopt new technologies to suit the local conditions remains a crucial first step to increase productivity (GoU, 2009).

1.1.2 Comparing the pro-poorness of AD and Western garment making technologies in Uganda.

The increasing rate of inequality and unemployment in Uganda poses challenges relating to growth and distribution, which also has implications for technological progress. Technological progress is a critical vehicle for growth since it is a key determinant of productivity (Kaplinsky, 2010). As indicated above, limited access to hard and soft garment making technologies and erratic supply of energy are among the major contributors to the sub-sector's low capacity in garment production (GoU, 2009). The country's traditional sources of garment making technologies—hard and soft—are the Western European countries, particularly Germany, United Kingdom, and Austria. However, operating and maintaining these Western made garment making technologies has been very difficult in Uganda (GoU, 2009). The Western technologies were produced to suit labour saving technological progress, assume high-quality infrastructure and produce products for high-income consumers (Stewart, 1982, and Kaplinsky, 2010). As such they depend on energy infrastructure to operate efficiently. However, the 85 % of the total population who live in rural areas do not have access to energy infrastructure and so may not be able to use such Western machines efficiently (GoU, 2009). This may limit the Western garment making machines to the remaining 15 % Ugandans who dwell in urban communities and have access to energy infrastructure.

In addition, access to spare parts as well as the requisite information required for maintaining and repairing the technologies are limited (GoU, 2009). Some of these technologies are designed to produce goods and services on large scale basis. They are also skills intensive and therefore require skilled labour to operate them efficiently (Kaplinsky, 1990). Above all, the Western garment making machines are relatively expensive and therefore, difficult for the poor to acquire. Hence, achieving an increased output and growth in the sector with the use of the Western technology may not be easy in a developing country like Uganda. However, over the past three decades, the global division of technological capabilities has been shifting from the

Western economies towards the AD economies (Kaplinsky, 2010). The very large size of the AD economies, coupled with their middle income status (only until recently they were low income economies) and, their growing technological capabilities make it likely that they will become the dominant sources of technological innovation for poor consumers in developing countries like Uganda (Kaplinsky, 2010). Again, the structure of the AD economies is different from that of the Western economies, hence by hypothesis, their technologies may be distinctive (Kaplinsky, 2010). This is because, technologies from AD countries—henceforth referred to in this thesis as "AD technologies"—are assumed to be labour intensive, easier to access, less capital intensive, require minimum skills and are tolerant to poor infrastructure (Kaplinsky, 2010). AD technologies are labour intensive because their production processes particularly in the garment sector utilise an assembly-type of operation which has proved expensive for further mechanisation (Elson and Pearson, 1981). With these attributes, the AD technologies have the potential of meeting Uganda's strategic objective of establishing micro and small scale garment making firms, supporting both employment creation and economic growth (GoU, 2008; and GoU, 2009).

1.2 Gaps in research

Despite the strategic importance of the garment sector to the Ugandan economy, not much attention has been given to it in the literature and even less to the impact of the AD economies and their technologies on this sector. Available studies have focused on the pros and cons of garments and textiles trade between the AD economies and Africa in general (see Zafar, 2007, Morris and Barnes, 2009, McNamara, 2008, and Morris *et al.* 2011). One of the key findings of these studies is that cheap Chinese garment and textile imports are undermining the garment and textile industry and increasing unemployment in Africa (Zafar, 2007; and Morris and Barnes, 2009). Though there is a growing presence of AD technologies on the continent, not much attention has been given to it in available literature. It is Kaplinsky (2010 and 2011) who assumes three sources of inducement to technological change in the AD economies. The first source of inducement is the growing demand by low income producers in developing countries for low cost products which are generally of low quality (Prahalad, 2005, Kaplinsky, 2010 and 2011). The second inducing factor is relative factor prices, quality, nature and price of infrastructure (Kaplinsky, 2010 and 2011). Wages in the AD economies are a fraction of those in the Western economies. Thus, it is highly likely that new techniques produced in these environments will occur in the context of weak infrastructure, particularly in relation to its quality and reliability and will be more labour intensive (Kaplinsky, 2010 and 2011). The third source of inducement is trajectories of innovation, as firms in AD economies build their capabilities over time.

In terms of whether there are alternative technologies (in this case AD and Western technologies); a well-behaved production function assumes a trade-off between capital and labour productivity (Clark, 1985 and Kaplinsky, 1990). But this might not be the case since the spectrum of available efficient technologies may be limited. Again, the neoclassical' assumptions about range of choice takes no account on scale. Moreover it assumes that factors are heterogeneous. The neoclassical framework further assumes only two factors in the production function—Capital and Labour (Pack, 1981, Stewart, 1982, Clark, 1985 and Kaplinsky, 2010). However, not much has been done to ascertain whether other factors such as the location and level of infrastructure available may play a significant role in determining the level of profitability of the technology. Compared to Western technologies, the AD technologies may be less skills intensive considering the fact that they are simple to use (Stewart 1982 and Kaplinsky 2010). Though this may all be the case, analysis on the frequent breakdown and skills requirements of AD technologies are largely neglected in literature. In order to fill the above gaps, this study examines the appropriateness of AD and Western technologies—specifically garment making machines in Uganda. In doing so I base the study on five important sets of literatures—the theory of hard and soft technology, technology transfer and diffusion, appropriate technology, technological change and choice as well as the rise of the AD economies.

1.3 Research questions

In order to have an organised approach to examine the overarching objective, the following research questions were considered:

- ✓ How is garment equipment from the AD and Western economies transferred to Uganda?

Answering this question will identify the easiest and cheapest means of technology transfer into the country. It will also unearth the challenges faced by importers in the transfer of technology into Uganda.

- ✓ Does the level of distribution of the AD garment machines differ from those of the Western ones in Uganda?

This question addresses the extent to which the AD and Western garment technologies are distributed in the country. It also compares the income distribution attributes of the two types of sewing machine.

- ✓ How distinctive are AD and Western garment machines in developing countries?

This analyses the physical properties of the two sources of garment making machines at each stage of the garment value chain. It also compares the level of skills requirements and the tolerance level of the garment machines to weak infrastructure. The comparison is made at both small and large scale levels of garment production.

- ✓ Does the degree of profitability of the AD garment making machines differ from those from the Western economies?

Answering this question will show whether the extent of distribution of the garment making machines originating from different parts of the world reflect profitability levels in urban and rural areas.

1.4 Organization of the study

The remaining study is organized into nine chapters.

Chapter 2: The rise of the Asian Drivers, the concepts of technology, choice, bias and technology transfer

This chapter maps out the theoretical and analytical framework utilised in this study. Concepts that were considered in the study include the concept of hard and soft technology, technique, choice of technologies, biased technical change and the rise of the Asian Drivers. In so doing, this chapter outlines how this study defines the terms 'technology', 'technique' and 'Asian Drivers'. The chapter defines a technique as the characteristics that are necessary for a specific application. The definition of technology is often associated with a hard or physical artefact but is in fact a set of techniques which include knowledge and skills necessary for a firm to use an application. The study describes China and India as Asian Driver economies. This definition encapsulates the Asian Driver economies' role in the transfer of both hard (physical) and soft (human resource oriented) technologies to developing countries like Uganda.

The chapter further discusses the production function and production coefficient, and its related assumptions in detail. It further describes the interaction between factor prices and the production function. This chapter also outlines different thinking relating to the theory of appropriate technology. This discussion focuses on issues relating to factor intensity, scale of production, infrastructure requirements as well as the skills requirements of a technology. Chapter 2 also introduces the related concepts of technology transfer and diffusion in order to understand how technologies reach users across national borders. Three forms of technology transfer are introduced: arm's length trade, foreign direct investment and cross border movement of personnel. Finally, the chapter makes a detailed analysis on the pros and cons of the rise of the AD economies in order to bring the discussion full circle to the issues being addressed by this thesis: the relative merits of AD technologies for garment making in Uganda and the lessons for pro-poor development in African economies.

Chapter 3: Conceptual framework and methodology

Discussions in this chapter started with an overview of the conceptual framework of the study. This conceptual framework introduces the links between the key research questions, the type of data collected and the expected outcomes of the study. The chapter goes on to discuss in more detail the research methods, instruments and the research processes that were used to collect the data. The data collected were obtained from both primary and secondary sources. The chapter also outlines the challenges that were encountered during data collection in both urban and rural areas of Uganda. The chapter further outlines how the data was analysed using thematic analysis for the qualitative data and descriptive statistics for the quantitative data. The Statistical Package for Social Scientist software was used to analyse the quantitative data. Ethical issues that were considered during data collection were also given attention in this chapter.

Chapter 4: A profile of Uganda and its garments sector

This chapter provides an overview of the state of the Ugandan economy. Issues pertaining to macroeconomic indicators such as inflation and interest rates are discussed. Poverty trends, employment rates as well as the state of Uganda's infrastructure are also considered in this chapter. It also provides an overview of the progress made by Uganda in meeting the MDG on poverty and employment in Uganda. The chapter then narrows the discussion to focus on the industrial sector with particular attention on the importance of AD and Western economies as sources of industrial machines. It also discusses the garments sector in Uganda and trends in the transfer of both AD and Western technologies in the sector, comparing the significance of AD and Western garment making technologies in bridging the technology gap in the country. Thus, this chapter sets the Ugandan garments sub sector in context.

Chapter 5: The operations involved in garment production in Uganda

This chapter describes the garment supply chain in Uganda. The discussion focuses on the operations and technologies involved in the production of garments. The chapter compares the characteristics of all the AD and Western capital equipment that are available along the supply chain. It describes the technologies in the context of their sources, where the technology can be used in Uganda, and the infrastructure and skills requirement of these technologies as well as the scale at which they can be used.

Chapter 6: The mechanism of transfer and distribution of the garment machines

Chapter 6 presents evidence on the mechanism of transfer and distribution of hard and soft garment technologies in Uganda. This includes where the equipment originates from, how it is transported to Uganda, the challenges importers encounter in the transport process and the extent of distribution of the garment machines in Uganda. The chapter also describes the extent of penetration at the small scale and large scale levels of garment production. In addition, the chapter discusses the role of AD experts in the transfer of hard and soft garment technologies into Uganda.

Chapters 7: The profitability of small scale AD and Western garment making technologies in Uganda

This chapter measures the level of returns from the AD and Western garment making machines at the small scale level of garment production in Uganda. The chapter also measures the coefficient of production of the two technologies and establishes the profitability of AD and Western small scale garment making machines. The chapter considered the location of the garment making machines in measuring their profitability levels. The chapter, focusing on the sewing machine as the machine of analysis, finds that AD garment making machines are more profitable in rural areas than the Western ones. The Western machines on the other hand appear to be more profitable in urban areas than the AD machines. Skills for repairing both the small scale AD and Western garment making machines are important for sustaining their use.

Chapter 8: Profitability of industrial large scale AD and Western garment making technologies in Uganda

This chapter compares the profitability of industrial AD and Western garment making machines in Uganda using again the sewing machine as the comparator technology. The chapter also describes the types of labour—permanent/supervisory and casual labour—available in a large scale garment production firm. The supervisors ensure that casual labourers—mostly sewing machine operators—sew the garment according to the specified pattern and design. The results of the analysis outlined in this chapter are briefly that the private profitability of the industrial Western machines is higher than those of the industrial AD machines. In addition, machine operators require on-the-job skills training and tacit knowledge to operate the machines.

Chapter 9: Appropriateness scenarios and their relevance to policy in Uganda

This chapter makes realistic assumptions with which to compare the amount of jobs and firms that can be created using the alternative garment making machines (AD as opposed to Western originated sewing machines). The chapter also examines the amount of surplus energy requirement as well as skills required for the two technologies given a fixed capital investment. This was premised on three important official documents in Uganda—the National Textiles Policy, The National Industrial Policy and the National Development Plan document for 2010/11-2014/15. The chapter concludes that manual AD machines create more jobs than the Western ones, though the former produces less quantity of garments. Furthermore, the AD technologies can be skills intensive and therefore may incur extra cost if government decides to invest in them.

Chapter 10: Conclusions, summary and recommendations

This chapter outlines the broad implications of the study based on the analysis and findings of all the chapters. In all, the study concludes that the AD economies serve as a source of both hard and soft technologies to developing countries. In addition, the study finds that the location of garment making machines in a developing country is important for determining the level of profitability of the technology. The study also finds that the AD technologies are skills intensive. This is contrary to the assumption that they are less skills intensive. The study further concludes that China and India are respectively becoming the main sources of hard and soft technologies for Uganda. Based on the findings, this chapter formulates policy recommendations relating to the need to create jobs, reduce inequality, and increase welfare in Uganda. The chapter also makes suggestions for future research.

CHAPTER 2 : THE RISE OF THE ASIAN DRIVERS, THEORY OF CHOICE, BIAS AND TECHNOLOGY TRANSFER

2.0 Introduction

The objective of this dissertation is to analyse the economic and social impact of using technologies from China and India in the Ugandan garment sector. In this chapter I define the key concepts which are used in my analysis of the garments sector, based on a review of the literature. This leads me to four sets of discussion. I begin in Section 2.1 by describing what I mean by technology, considering the differences between technology and technique, hard and soft technology, efficient and inefficient technology, and appropriate and inappropriate technology. I also consider bias in technology change and the inducements to bias. Then in Section 2.2, because Uganda does not produce hard garment technologies and has a weak soft technology capability, I discuss mechanisms whereby technologies can be transferred to Uganda. In Section 2.3 I explain how China and India have become important actors in sub-Saharan Africa including as a source of technology. I end the chapter in Section 2.4 by providing a matrix which combines two important elements of this discussion which are relevant to my analysis – hard and soft technology, China and India as different actors, and mechanisms of technology transfer. I will return to this matrix at the end of my dissertation in Chapter 10 to provide an overall assessment of these two AD economies on poverty and growth in the Ugandan garment sector.

2.1 Technology and technique: definitions and choice

This section outlines the relationship between the concept of technology and technique. This will unravel the fact that: (i) a technique is the set of characteristics associated with a specific application that make up a technology and (ii) that a technology is a broader concept, representing the set of knowledge and capabilities which provide the opportunity and setting for the development of specific application (that is, techniques)

(Mokyr, 2003 and Jin, 2005). Techniques may not only be composed of the physical artefacts ("hard technology") but also of knowledge, skills, routines and organisation ("soft technology") (Mokyr, 2003). I further discuss the determinants of technical choice, the nature and direction of technical change and the inducements to technical change. The fact that technical change does not follow a Darwinian path also leads me into a discussion of appropriate technology.

2.1.1 Technology and technique, hard and soft technology

Technology is central to economic growth. The centrality of technology to growth was established by Abramowitz (1956) and Solow (1957) who showed that technological progress was the major source of economic growth, rather than just adding more capital and labour which had previously been considered to be the sources of growth. I begin by discussing the difference between technology and techniques. The concept of technology describes a broad family of techniques, such as electronics, internal combustion engines and garment manufacturing. Within this concept of technology are a number of specific techniques (Stewart, 1982, Clark, 1985 and Kaplinsky, 1990). For example, in internal combustion engines, there are four-cylinder, six-cylinder and eight-cylinder engines. Within the sewing part of garment technology, as we shall see, there are a variety of different types of sewing machines – that is techniques - such as treadle and hand-driven manual machines, and manual and power-driven machines. Each of these techniques will have specific characteristics. Thus a technique is associated with a unique and specific set of characteristics including the artefact, the skills, the management practices, and other factors such as energy inputs, water use, etc (Mokyr, 2003). All of these characteristics are important in determining whether a firm can adopt a technique (Stewart, 1982).

Many studies do not focus on the soft aspect of technology. They mainly pay attention to the physical component of technology. For instance, Clark and Staunton (1989) define technology as machines and equipment that are employed in a production process. Jin (2005) indicates that hard technology exists because of invention which in turn is the result, according to Schoffner *et al.* (2000), of its physical usefulness to society. These tangible physical technologies can be termed "hard technology", and in the case of specific applications, "hard techniques". They are also commonly referred to as artefacts (Mokyr, 2003). For many years, hard technology has dominated the description of technology (Schoffner *et al.* 2000).

However, Burgess and Gules (1998) argue that hard technologies are usually implemented in isolated pockets and therefore make a weak impact on an organisation's output. They argue further that the knowledge associated with a technology is very important for its efficient operation. Thus a technology cannot be useful if it is not accompanied by the requisite knowledge it requires for its operation. For instance, what is done with a sewing machine as a specific technique depends on the way it is used by the sewing machine operator, how it is incorporated in a wider production process and even the machine repairer in the case of machine breakdown (Mokyr, 2003). These skills and procedures are termed "soft" technology. Soft technology depends on a combination of specific procedures, skills and organisation. In order to ensure efficiency, there is the need for effective coordination between hard and soft technology.

The development of soft technology is a result of the gradual and deliberate approach of acquiring the knowledge embodied with the technology (Dobler *et al.* 1990 and Lamming, 1993). The acquisition of knowledge, how it is used and passed on in an economy is key to economic growth (Jensen *et al.* 2007). Specifically, two forms of knowledge have been recognised as important for ensuring economic growth: codified knowledge and tacit knowledge (Polanyi, 1966, Nelson and Winter, 1982, and David and Foray, 2001).

Jin (2005) explains that tacit knowledge requires 'thinking technology' and cannot be properly presented easily in a written form, often being embodied in a technology. It is difficult to communicate tacit knowledge in a formal manner or standardised manner (Jin, 2005 and Bascavusoglu, 2005). Experience is important in mastering tacit knowledge and the transmission of tacit knowledge almost always requires face-to-face interaction. David and Foray (2001) on the other hand argue that writing knowledge down is one way of codifying tacit knowledge. This is one of the surest ways in which knowledge can be passed on to others and be understood by those who can read and understand the language. However there are limits to the ability to codify tacit knowledge and Johnson and Lundvall (2001) argue that in reality codified and tacit knowledge goes 'hand in hand'.

In general, developing countries lack both forms of knowledge. In recent years there has been increasing recognition of the need for these developing economies to develop and acquire knowledge capabilities (Kim, 1998). This is because of the successful economic catch-up of some developing countries, notably in Asia, which has been attributed to their growing command over the management of codified and tacit knowledge (Kim, 1998). However, to fully understand how technology is produced, how it is chosen and what its impacts will be, it is necessary to consider the concept of the 'production function' in the next section.

2.1.2 The production function and choice of technology

In this section, I discuss the production function with an emphasis on the objections that have been raised with regards the neoclassical framework. The section also discusses choice of technique.

A. The production function

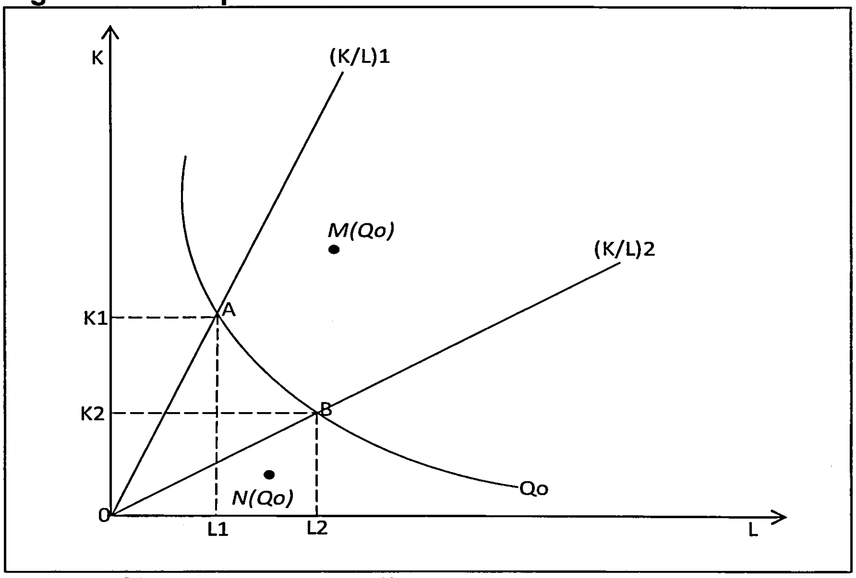
The production function focuses on the quantity of output (Q) that a firm can produce as a function of the quantity of inputs to production (Clark, 1985, Solow, 1957, and Arrow et al. 1961). In his work titled "Technical Change and the Aggregate Production Function", Solow (1957) introduced a simple theory of segregating shifts of the aggregate production function from movements along it. This was followed by Arrow *et* *al.* (1961) who developed what is known as the Arrow-Chenery-Minhas-Solow production function (constant elasticity of substitution). They did this by using data on wages and output at the firm level from 19 countries to show the importance of making assumptions about the extent to which capital and labour are substitutable for each other. Equation 1 below is the production function showing capital and labour, with technology assumed to be given. Each of these production functions describes a specific technique, using the term as I defined it in Section 2.1.1.

$$f(Q) = Q(T; K, L) \qquad (1)$$

Where *Q, T, K,* and *L* represent output, technology, capital, and labour respectively.

In order to avoid complications in the analysis of the production function, it is generally simplified to include only capital (K) and labour (L) as factor inputs producing a given output (Clark, 1985 and Bhalla, 1985). Putting the model this way helps in the determination of the optimal combination of factors. Figure 2.1 provides a graphical representation of how the production function can be used to determine the optimal combination of factors—capital (K) and labour (L). The isoquant *Qo* represents the different input level combinations producing the same level of output. This is useful for the determination of factor intensity and substitutability. The ratio between capital (K) and labour (L) (i.e. K/L) measures capital intensity (relative to labour) of a production system.

Figure 2.1: The production function



Source: Clark (1985, page 81)

Assumptions pertaining to the production function

The production function assumes the following:

I. Infinite range of efficient techniques available for the production of a given output—goods and services.

II. Capital and labour are assumed to be the only inputs into production

III. Inputs and outputs are homogeneous

IV. Objection to the assumption of identical product

V. No regard for the differences in economies of scale production.

(see Bhalla, 1985, Amsalem, 1983, Ruttan, 2001, Kaplinsky, 1990 and Kaplinsky, 2010).

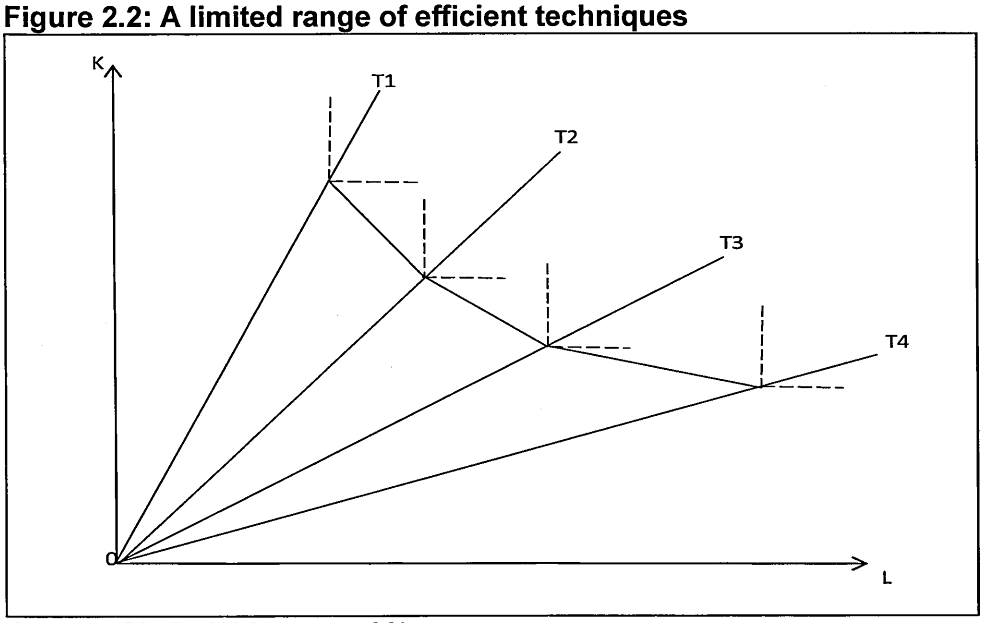
These assumptions have received a number of objections. I discuss each of these objections below.

Objections to the assumptions in the neo-classical production function

I Assumption on infinite range of efficient techniques

The production function above (i.e. Figure 2.1) is assumed to be continuous with an infinite range of techniques along the isoquant *Qo*. However, this may not be the case in reality (Clark, 1985). Figure 2.2 illustrates four techniques—T1, T2, T3 and T4 on an engineering production function. These four techniques illustrate the actual number of technical choices a manufacturer is privy to at any given period and which might be close to an empirical measurement of the production function using a statistical approach. Following the production function in Figure 2.2 will violate the properties of the production function in Figure 2.1 above (Clark, 1985). Eckaus (1955) provided important and influential dissenting views to the idea of an infinite range of efficient techniques. He argued that at any given period of time, there is only one efficient technique; and these efficient techniques are capital intensive in nature. He argued that this was because research and development and innovation were concentrated in developed economies where wages were high and capital was cheap.

Figure 2.2: A limited range of efficient techniques



Source: Clark, (1985, page 82)

II. Critique on capital and labour as the only inputs

Studies such as Stewart (1982), Amsalem (1983) and Kaplinsky (1990) argue that inputs that go into production are not confined to capital and labour. Other inputs such as hard and soft technologies, utilities, raw materials, semi-processed intermediate products and services must also be taken into consideration (Kaplinsky, 1990). Garment production for instance cannot be successful if only the sewing machine, factory and labour are considered as factors for the production process. It requires energy to drive the machinery and fabric and components to make the garments.

III. Critiquing the assumption homogeneity of factors

The neoclassical production function assumes that factor inputs are homogeneous in quality. However in practice, factors may differ in nature (Amsalem, 1983). Bhagavan (1979) pointed out that there is skills differentiation in the labour employed for different techniques. He explained that in developed economies, the use of techniques (usually capital intensive) require skilled/semi-skilled labour, and supervisors. The level of training that is given to these different categories of labour varies. For instance, supervisors are given special training to supervise their subordinates in the operation of the various categories of technologies available in garment production (Amsalem, 1983). This training also introduces an investment cost in the measurement of labour and this varies from one technology to another (Amsalem, 1983). In the case of capital measurement, large proportions of investment cost relate to raw materials and intermediate products (also known as working capital) and these factors are neglected in the neoclassical assumption of homogeneity in factor inputs. Moreover, different machines have different operating characteristics (e.g. sensitivity to quality of infrastructure and climate).

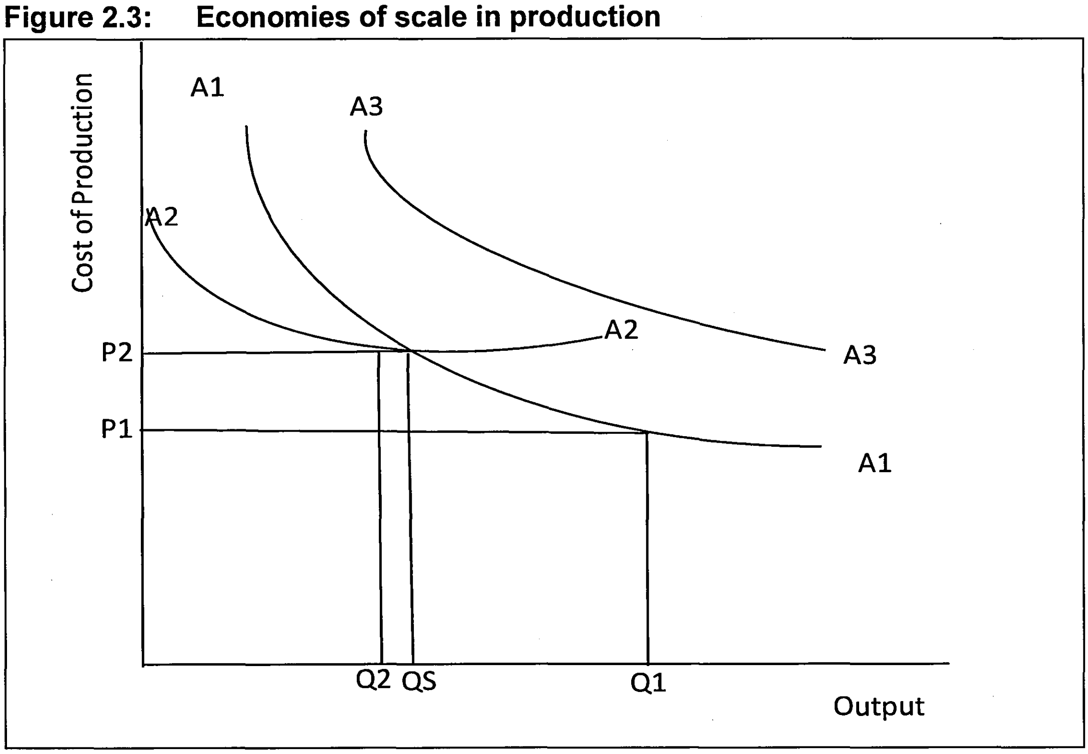
IV Objection to the assumption of identical product

The neoclassical framework assumes that available techniques produce identical products. But in the real world this is patently not the case (Kaplinsky, 1990). Lancaster (1966) argued that at any point in time, there is a limited range of products available to meet the requirements of consumers more effectively than their inefficient alternatives. He further argues that efficient products (that is products which meet a variety of consumer needs more effectively) are developed in high income economies and also meant for consumers in these high income economies. Critically, specific production techniques produce specific types of output. For example, in garment production, labour intensive machinery may not be able to produce the quality levels demanded by high income consumers.

V. Objections to the assumption of no regard for difference in economies of scale production

The neoclassical framework makes no reference to scale. Thus Figure 2.3 does not consider scale in the determination of choice. Yet, it is a very important determinant of choice. Figure 2.3 plots average production cost with the scale of operation. Relative to technique A2 (P2), production technique A1 has a lower unit production cost (P1). Therefore all things being equal A1 will be the appropriate choice of technology. But technique A1 achieves this lowest cost with a considerable higher scale of output (Q1) (Figure 2.3). At output below QS, the unit cost of A2 is lower than that of A1 (Figure 2.3). Therefore A1 cannot realise its cost advantage unless it operates near its optimum scale. The small nature of the market, difficulties in market penetration, social and environmental requirements can render it impossible to realise these economies of scale (Kaplinsky, 1990).

Figure 2.3: Economies of scale in production



Source: Kaplinsky (1990, page 32)

B. Efficiency in the choice of technique

One of the strengths of the economic production function is that it helps to explain why specific techniques are chosen. It assumes that the choice is made as a consequence of factor prices, and this is important in the real world, since capital and labour are generally the most important costs in the manufacturing sector and a firm will seek to produce when the production cost is lowest. In general, it would be expected that in developing economies where wages are low, labour intensive techniques would be chosen. However, the labour intensive techniques may not make economic sense if they are what economists refer to as "inefficient". In economic theory there are two different types of efficiency. These are: technical or "engineering efficiency" (the most efficient transformation of material inputs), and economic efficiency (making the most productive use of a given set of resources). From the firm's point of view, while the engineering efficiency may be an important factor in costs, the key factor is the economic efficiency of the technique.

"Economic" efficiency

In an economically efficient system, the maximum amount of output is realised from the available factor inputs (Levin *et al.* 1976). In other words, resources are not wasted in the production process, that is, there is no possibility of increasing output without increasing one or more inputs. Figure 2.3 above showed graphically the nature of "economic inefficiency", that is, a technique which uses more of both capital and labour than the alternative "efficient" techniques. Three important ratios ("the coefficients of production") are involved in the calculation of "economic efficiency", based on the level of output of the firm, and its use of capital and labour. These are:

The productivity of capital (O/K) – output divided by capital

The productivity of labour (O/L) – output divided by labour

The capital-labour ratio (capital intensity) (K/L) – capital divided by labour

In the case of "economically efficient" techniques, the more capital intensive technique will have a higher productivity of labour, but a lower productivity of capital. The more labour intensive techniques will have a lower productivity of labour but a higher productivity of capital. From the point of view of a developing economy where wages are low and capital is expensive, in principle it makes sense to use more labour intensive techniques. However, the "optimality" of choice (that is the technique which produces the highest profit) will depend on the relationship between the coefficients of production and the relative costs of labour and capital. What the concept of "economic efficiency" does show is that these techniques represent the spectrum of available techniques from which an "optimal choice" can be made. But this "optimal choice" will depend on factor prices.

An "economically efficient" technology may not always be the yardstick for technological choice. I have already described a series of assumptions which are in the economic model and which limit the role played by this concept. But in addition, there are other non-profit considerations which affect the choice of technology. This leads me to a discussion of appropriate technology

2.1.3 Appropriate technology

Inspired by Ghandi's emphasis on village level pro-poor technologies, Schumacher (1973) pioneered the appropriate technology movement. He argued that large-scale mass production technologies are inappropriate for developing countries. This is because they are too sophisticated, capital intensive, high energy-input dependent as well as labour saving; characteristics, he argued, not suited to most developing counties. Therefore, he proposed the use of £100/worker techniques in developing countries rather than £1000/worker techniques that have the above attributes (Schumacher, 1973). He coined the phrase *intermediate technology* to describe the technologies he believes to be appropriate in developing countries (Schumacher, 1973, p. 125-126). According to Kitching (1982), Schumacher coined the phrase *intermediate* *technology* to show that appropriate technology is both small scale and labour intensive but not simply traditional. Kitching (1982) added that Schumacher's advocacy can also be relevant for developed countries.

Schumacher's proposal gave rise to the publication of three major studies by the Organisation for Economic Co-operation and Development (OECD) (1976), The World Bank (1976), and the United States Agency for International Development (USAID) (1976). The three publications made a very strong argument against the reliance on Western capital intensive technologies in developing economies. They argued that developing countries do not have the capacity to generate resources—financial, human and infrastructural—that would mitigate the developmental challenges in key sectors of their economies. The three documents further argued that capital intensive technologies generally have socially disruptive repercussions and in many cases were introduced in developing economies as a result of distorted factor prices and protection.

The technologies tended to produce for either the high income group of the domestic economy and/or for export purposes. They argued further that capital intensive technologies are usually not adapted for the supply of labour in developing countries. Hence, the industrial sector generally suffers from under-utilised capacity and excess downtime. This stifles growth of technological capacity and innovation in developing countries. It also led to very adverse developmental outcomes.

The traditional appropriate technologies movement as espoused by Schumpeter and the international organisations in the 1970s and 1980s were overwhelmingly driven by not-for-profit organisations. More recently though, the rise of emerging economies such as the AD economies suggests that this dominant trajectory may be subject to change and that "for-profit appropriate technology" may become increasingly prevalent. This is driven not just by the growth in capabilities in these economies but also because the rise of the AD economies has coincided with a rapid growth in demand by poor consumers. These poor consumers may aspire to branded positional goods, but because of their low incomes will settle for simpler and lower quality products (Kaplinsky, 2010). This form of demand from poor consumers has reignited the appropriate technology concept with the AD economies serving as the source. As explained by Kaplinsky (2010), the AD economies' ability to produce technologies for low income consumers in developing countries deviates from the historic trend where technologies have been mainly produced for high income consumers in developed countries.

Furthermore, the appropriate technology, choice of techniques, and even transfer of technology literature became pervasive in the 1970s. However, interest began to fade off in the early 1980s onwards. For instance the London based Intermediate Technology Development Group Limited conducted a survey which showed that the number of institutions in the world operating under the topic of appropriate technology grew from a handful in the early 1970s to almost five hundred by the late 1970s (Whitcombe and Carr, 1982 and Willoughby, 1990). However, between the early 1980s and 2000s there has been a gap of interest in the study of appropriate technology, transfer of technology and choice of techniques. This study contributes to literature in this regard.

2.1.4 Bias and sources of inducement in technical change

In Section 2.1.2 I discussed the economic perspective on choice of technique, showing how firms will try to use the lowest cost technique and how this choice is affected by the use of capital and labour, the two largest cost items (in terms of value addition) in production. In Section 2.1.3 I discussed how some of these decisions may help a firm to identify an appropriate technology. These discussions assume that there are alternative types of technologies, and it is important that I now also discuss the direction which these alternative technologies may take. This leads me to the discussion of bias in technical change.

Hicks (1963) and later, Kennedy (1964) and Solow (1957 and 1968) were among the pioneering group of scholars who introduced the concepts of bias and direction of technical change. It was Solow (1957) who used the phrase "technical change" to illustrate any kind of shift in the production function. Solow indicates that

> *"….. shifts in the production function are defined as neutral if they leave marginal rates of substitution untouched, but simply increase or decrease the output attainable from given inputs"* (Solow, 1957, page 2).

But technical change can take a number of directions. "Neutral" technical change can increase the productivity of capital, labour and other factors of production in equal terms. But technical change can also be biased towards a specific factor (Ruttan, 2001). It may use relatively more of one factor (for example, capital in the developed countries where wages are high) compared to another. So, technical change can also be labour-saving, or capital-saving as well as being neutral. It also can affect other characteristics of technology such as scale, the skills required of the labour force, the types of knowledge that are required to operate the techniques, their requirements for utilities such as energy and so on. It is therefore necessary to also consider those factors which induce technological change to go in different directions. Three main sources of inducement can be identified to explain the direction of technical change. These are: demand, factor endowment and trajectories of innovation (Ruttan, 2001).

I. Demand as a source of inducement

Demand as a source of inducement to technical change was initially introduced by Griliches (1957) and Schmookler (1966). Griliches (1957) undertook a classic study on invention and diffusion of hybrid maize to show the role of demand in determining the timing and location of invention. Schmookler analysed patent statistics on inventions in four industries—railroads, agricultural equipment, paper and petroleum—and concluded that demand (as opposed to supply) was more important in stimulating technical change

(Schmookler, 1962 and 1966). Other studies like Lancaster (1966) also provided an analytical framework to analyse the biases associated with product characteristics.

The nature of demand for a particular type of product affects technical change (Kaplinsky, 2010). High income markets for instance (mostly in the industrialised advanced countries) place a lot of prominence on product quality and differentiation and as such can be tolerant of high acquisition costs. On the other hand low income countries are likely to be prepared to forgo product quality for low relative prices and acquisition costs. Earlier studies like Griliches (1962) and Schmookler (1966) provided empirical evidence to show how demand can induce technological change. However, not much attention has been given to it in contemporary studies. Ruttan (2001) cursorily indicates that changes in demand are potent inducement sources for the allocation of research resources. Kaplinsky (2010) only indicated that innovations producing low cost products are likely to originate from the AD economies but did not provide in-depth evidence. Furthermore, not much attention has been given to the factors (e.g. access to adequate information on the technology) that stimulate demand for technologies.

II. Factor endowments

Ruttan (2001) underscores relative factor prices as a key factor in the direction to technical change. Hicks, an authority on the direction of technical change observes that

> *"The real reason for the predominance of labour saving inventions is surely that … a change in the relative price of the factors of production is itself a spur to innovation and to inventions of a particular kind – directed at economising the use of a factor which has become relatively expensive"* (Hicks, 1963, page 12).

Fellner (1961) emphasises this point by observing that expectations of changing prices play a significant inducing role in biases in technical change. Thus, a firm in a developing country will aim at price equalisation by shifting towards cheaper factors and away from expensive ones, leading to a more equal factor prices (Fellner, 1961).

III. Trajectories of innovating firms

The third factor that induces technical change pertains to the trajectories of innovating firms (Ruttan, 2001). In their efforts to improve upon their products and processes, firms are always confronted with the challenge of scanning through their known contacts and data-sources mainly due to the availability of imperfect information. In the context of routines, firms are able to store past data and contacts to enable them to keep track of their previous operations so as to improve upon them (Kaplinsky, 2010). These firms have their own path-dependencies and trajectories (Dosi, 1982).

2.2 Transfer and diffusion of technology

Once a technology has been produced it needs to be diffused or transferred for use by producers and consumers. These end users may be other companies or individuals or households, depending on the technology. Uganda has a poorly developed technological capability and a weak industrial sector. Therefore, access to technology requires the import of technology. There are two main literatures that discuss the inter-country transfer of technology and then the internal diffusion of these technologies. The first is the technology transfer literature which is relevant in the case of the Ugandan garment industry where very few hard and soft technologies can be produced in-country and therefore must be imported. The second literature relates to how these hard and soft technologies are then diffused within the market. I will now discuss each of these literatures.

2.2.1 The concept of technology transfer

Sahal (1981) indicates that the mode of technology transfer should be specific to the set of processes and products. In addition he makes the important point that technology transfer must involve the transfer of both the hardware and soft knowledge associated with it. Transferring only the hardware (i.e. machine) without the soft technology will make the transfer process ineffective (Sahal, 1981 and Sahal, 1982). Sahal's definition has been validated by a recent survey by Li-Hua (2006). He undertook a structured survey of the effectiveness of technology transfer in China and arrived at the conclusion that technology transfer in China has become efficient because the transfer process combines both hard and soft technology.

There are different modes by which technology transfer can be successful. There is wide agreement in the literature that international trade, foreign direct investment (FDI), technology licensing and cross border movement of personnel are the main modes of transfer of technologies from one country to another (Milner, *et al.* 2013, Morrissey and Rudaheranwa 2012, Rudaheranwa, 2009, Maskus, 2004, Nicholson, 2002, Smith, 2001, Coe, *et al.* 1997, Markusen, 1995, Lee and Mansfield, 1996, Borensztein *et al.* 1998, Mansfield and Romeo, 1980, Wang 1990, and Findlay, 1978).

I Technology transfer through international trade

International trade is central to technological change and forms the main vector of technology transfer for developing countries (Coe *et al.*1997, and Maskus, 2004). This involves the movement of machinery and in some cases soft technology from its country of origin to the recipient country (Wahab *et al.* 2012). International trade is one of the cheapest and fastest means of transferring a technology from its origin to the recipient country. However, the cost of transfer through trade varies according to the location of the recipient country (Faye *et al.* 2004, Milner *et al.* 2013, Morrissey and Rudaheranwa, 2012). A landlocked country will incur higher costs in transporting a technology than its maritime neighbour. For instance, the cost of transporting a technology to Uganda is higher than that of its neighbours—Kenya and Tanzania (Rudaheranwa, 2009).

Milner *et al.* (2013) use data from a range of sources to estimate transport costs for imports to, and exports from, Uganda. They calculated the effective protection of imports and implicit tax on exports due to transport costs and compared it to the effective protection due to trade policy barriers. Their results show that high transport costs are more harmful to Uganda than bad trade policy. Milner *et al.* (2013)

recommend improved infrastructure and institutional support to facilitate trade and reduce the adverse effects of natural barriers. Furthermore, the recipient country must have the requisite technical competence to be able to absorb the technology. An important observation on trade as a mechanism for technology transfer is that it almost entirely only affects the transfer of hardware. As I have discussed above, technology includes not just the hard component but also soft—skills, knowledge and organisation, etc.

II. Foreign direct investment (FDI) as a channel of technology transfer

OECD (2013) defines FDI as cross-border investment by a resident entity in one economy with the objective of obtaining a lasting interest in an enterprise resident in another economy. Available studies have shown that FDI as a means of technology transfer is sometimes a sufficient condition for increased productivity and economic growth in a recipient's country. It is also argued to be one of the cheapest means of technology transfer as the recipient country normally incurs no cost in the acquisition of new technologies (Mansfield and Romeo, 1980). Borensztein *et al.* (1998) explain that to be successful FDI as a means of technology transfer generally requires imports of products, adoption of foreign hard technology and acquisition of soft human capital. However, Borensztein *et al.* (1998) identifies acquisition of human capital in a host economy as the key challenge for successful technology transfer. That is why Mansfield and Romeo (1980) stated that FDI as a means of technology transfer can generally only be successful if there is available capacity such as skilled labour to absorb the transferred technology. This also means that FDI can be a very good conduit for technology transfer in one developing country but may fail in another if there is not adequate capacity to absorb the technology (UNCTAD, 2010).

One of the important motivations for multinational firms to invest in a foreign country is to create a bigger market for their technologies (Markusen, 1995). This often takes the form of licensing contracts. Mansfield (1994) conducted a survey on U.S patents and inward FDI in developing countries. He drew two major findings—that lagging technologies were transferred to countries that have weak/do not have the regulatory framework for technology transfer. He further indicates that production and research facilities were less likely to be established in these economies.

III Cross border movement of people

The transfer of soft technology is an important part of technology transfer. Cross border movement of technical and managerial personnel is one of the most important channels for the transfer of soft technology. This happens when the technology requires the complementary services of engineers and technicians who must be on-site for some period of time to ensure proper installation and efficient operation of the machines. This may lead to the transfer of skills from expatriate workers to local workers in recipient countries. However, this may be more restrictive and less flexible, raising the costs of such transfer and absorption (Maskus, 2004). In the short run, the immediate recipients of new technologies can gain higher productivity while at the same time it can lower the cost of production. This is because the firm may be able to host and employ the expert who has crossed borders for their production activities; however this may not be sustainable over a longer period of time (Maskus, 2004). The long run effects depend on the extent to which recipients of the technology are able to develop their own capabilities (Maskus, 2004).

It is important to note that the three modes—International trade, FDI and cross border movement of people—of technology transfer can be interdependent. A firm may decide to import a machine and at the same time import an engineer to install and ensure its efficient operation. Again through investment, a multinational company may decide to import its technical staff for its operations. The decision on the mode of technology transfer depends on the complexity of the technology and the capabilities and objectives of both the transferor and recipient of the technology. The policy environment can also affect the behaviour and decisions of the two actors (transferor and recipient) (Maskus, 2004).

Though important for a landlocked country like Uganda, little research has been conducted to investigate the relevance of these modes of technology transfer for the growth of its manufacturing sector. Mutambi *et al.* (2013) stresses the need for small and medium scale enterprises to develop their internal capacity through efficient adaption and use of products and process technologies imported into the country. Moreover, the technology transfer literature has not sufficiently addressed the issues confronting Uganda as a landlocked country. Only Milner *et al.* (2013), Morrissey and Rudaheranwa (2012), and Rudaheranwa (2009) capture this as an issue. Even these focus mainly on trade policy and the hard technology and less on soft technology transfer into the manufacturing sector. Furthermore, there are not many empirical studies to show the role of the AD economies in the transfer of both soft and hard technology to developing countries, and specifically not to Uganda. Available studies mainly consider the transfer of technology from Western economies (see Maskus, 2004, Bozeman 2000 and Stewart, 1982).

Technology transfer has invariably been looked at from the perspective of technologies moving from a developed economy to a developing economy. Studies like Emmanuel (1982) argued that there is only one source of efficient technology and these technologies originate from the Western economies. Other studies such as Archibugi and Pietrobelli (2002), Liu (2006) and Wahab *et al.* (2012) have shown that technologies originate from the developed economies to developing economies or they compare technologies from developed economies and those locally produced (see Pack, 1981, and Cooper and Kaplinsky, 1974). Few studies (such as Aggarwal, 2011 and Dutt, 2013) focus on those transferred from a developing economy to another developing country. Hoekman *et al.* (2004) have also emphasised the encouragement of an appropriate technology transfer policy to encourage technology transfer into a developing country. This study goes a step further to compare the transfer of technologies from AD economies and developed countries to another developing country (i.e. Uganda) (see Chapter 6 below).

2.2.2 Diffusion and adoption of technology in an economy

A technology (hard or soft) transferred cannot have a wide developmental impact if the technology is not well diffused and adopted in the wider economy. This is why studies such as UNCTAD (2010), Bozeman (2000), Teece (1977), and Arrow (1969) consider diffusion and adoption as complementary processes. Diffusion as defined by Rogers (2003) is the process whereby a technological innovation is communicated through certain channels among a social system[1] over time. A technological innovation is said to have diffused when it achieves a wide distribution among a group of consumers who have recognised its potential (Nordin *et al.* 2014). Although Rogers (2003) was mainly concerned with the diffusion of innovations (whereas I am concerned with the transfer of established technologies), his work is helpful and I will use this to discuss three factors which affect the diffusion process—the communication channels, the time of diffusion and uncertainty as an obstacle to adoption.

I. Communication

Communication concerns the dissemination of new ideas to members of the social system (Rogers 2003). It requires two or more individuals or institutions exchanging information in order to understand the composition and function of the new innovations (Rogers and Kincaid, 1981). Information dissemination is very important for the success of the diffusion process. The medium of communication determines the extent to which information about the technology will be disseminated. For instance, mass media is one of the easiest and most efficient approaches for information dissemination. It provides free awareness on the technology and also covers a wider range of areas (Kasmire *et al.* 2012). Interpersonal channels cover smaller audiences but are often more effective considering the fact that it involves a face-to-face exchange between two or more individuals (Kasmire *et al.* 2012). Technologies can be complex and so may require more than just information for the technology to be adopted (Kasmire *et al.* 2012).

[1]Rogers (2003) describes the social system as individuals, companies or governments.

II. Time of diffusion

The time it takes an individual to pass knowledge on to a recipient of a technology also affects the pattern of diffusion. It begins from the period an individual decides to pass on the first knowledge about a technology to the recipient. There are a number of other stages when communication time is important as the technology passes from the originator down the various stages until there is widespread adoption (Narayanan, 2013).

III. Uncertainty as an obstacles in the process of diffusion

One of the main obstacles for adoption of technology is uncertainty (see Rogers, 2003 and Kasmire *et al.* 2012). Technology adopters are usually cautious and sceptical of any new technology they adopt. Understanding the nature of uncertainties and the obstacles in the adoption of technologies informs how new technologies are developed for an economy. It shows the extent to which these technologies are diffused and their eventual impact on economic performance and welfare (Rosenberg, 1996). It is one of the reasons why innovating firms have historically experienced high failure rates (Rosenberg, 1996). Uncertainties are assumed to be reduced after the first commercial introduction of a new technology, and it was Schumpeter who deepened the acceptance of this assumption. But as discussed above, this will require sufficient information dissemination for it to be successful (Sahin, 2006).

IV. Categories of adopters

Rogers (2003) categorised technology adopters into five main groups—innovators, early adopters, early majority, late majority, and laggards. Innovators are those groups who are eager to experiment new ideas. They have access to financial resources and have the skills for doing new things. They are risk takers and are capable of bringing on board new innovations that may be unprofitable. They launch new ideas into a system by importing it from another system. Therefore they serve as the means of entry for new technologies (Narayanan, 2013).

The early adopters are the immediate receptors of the new technologies and are the most respected group of technology consumers. They are responsible for reducing uncertainties about the technology and also inform others about the properties of the new technology.

The early majority adopters tend to interact very well with their peers seeking information about the technology before they adopt it.

The late majority adopters adopt technologies based on some socioeconomic needs. They have relatively scarce resources and so are cautious and sceptical when it comes to the adoption of technologies. They seek information from those who have already adopted the technology to find out about the properties of the technology.

The last group to adopt a technology are the laggards; they usually adopt the technology at the time new technologies are being introduced by the innovators (Rogers, 2003).

V. *Rate of adoption of the technology*

Rogers (2003)'s categorisation of technology adopters is based on the speed in which new technologies are adopted. The number of adopters starts slowly and then accelerates to a point where a larger number of people have access to it. After that the number of adopters begins to decline gradually after the rate of adoption has reached its peak. Theoretically, the basic process of adoption is terminated by the reduction in the number of new adopters and saturation of the market but also as a technology becomes old and outdated (Peres *et al.* 2010). This literature on the diffusion of technology mostly comes from a discussion of the diffusion of innovation. But it also affects the inter-country transfer of technology where the channels of communication are a problem, especially in the case of poor economies such as Uganda. Users of technology in developing countries are like Rogers' late majority and laggard users, and uncertainty is often very important in their lives.

Although Rogers' study is helpful, it does not meet the specific conditions of developing economies. In developing economies, diffusion of imported technology is also affected by other factors which are often not present in developed countries. Infrastructure may be weak. The infrastructure requirement of a technology influences the extent to which it will be diffused. For instance, a technology that requires high energy infrastructure may not be adopted by users who do not have electric power. Consideration of evidence on this is scanty in the diffusion literature. Communication channels may also be slow, especially regarding users in rural areas, many of whom are illiterate. Studies like Blackman (1999), Archibugi and Pietrobelli (2002), and Comin and Hobijn (2010) are among the few empirical studies that consider information as a means of diffusion in developing countries. This study adds to literature by showing the importance of information dissemination as a means of diffusing soft and hard technologies in the manufacturing sector.

Attention on finance as means of technology diffusion is also very important in developing economies. Studies like Comin and Nanda (2014) are among the few that focus on financing technology diffusion. However their study focused on the role played by well-developed financial markets in the reduction of frictions associated with the adoption and diffusion of new technologies. Other studies such as Spolaore and Wacziarg (2011) have also shown that failure to provide financial support in the distribution of technologies can prevent or delay the adoption of specific technologies. But these studies focus mainly on the diffusion of Western technologies and not AD technologies.

2.3 Asian Drivers as a mode of technology diffusion

The inducements to innovation in AD economies are different to those in Western economies; wages in AD economies are generally low. Therefore, innovations from the AD economies are often labour intensive (Kaplinsky, 2010). In many cases, these economies also suffer from a deficit of skilled labour and users are often illiterate or semi-literate at best. These labour intensive innovations are also produced in the context of weak infrastructure environments, with unreliable energy and poor transport communications. These technologies are often also produced in the context of small markets in which it is difficult to realise scale economies. Consumers in AD economies are often poor and this is more similar to other developing economies such as Uganda than are consumer markets in the Western economies.

Southern-based corporations like those in China and India could be argued to be in the best position to develop technologies to serve the needs of low-income economies. The reason is that large multinational firms in the Western economies mostly focus on the demands from their existing customers and disregard new technologies that will not satisfy the needs of their existing customers (Christenson, 1997). This challenges Prahalad (2005)'s belief that there is a huge market opportunity for transnational corporations (TNCs) in developing economies. The conditions inducing technologies in AD economies suggest their technologies may be 'appropriate' being labour intensive, have low capital cost, tolerant to poor infrastructure, small in scale, but may not meet the needs of high income consumers.

Because of these inducement factors, the AD economies are an important potential source of appropriate technology for other developing economies. But this potential has been under recognised and their actual impact has not been explored empirically. Studies on FDI from the AD economies to developing countries have focused mainly on primary commodities but not technology transfer into the manufacturing sector (see Farooki and Kaplinsky, 2012; Dent, 2011 and Brautigam, 2009). For instance, Farooki and Kaplinsky (2012) analysed the effects of FDI from China on the commodities sector for poor countries. Brautigam (2009) also examined the relationship between FDI from China in the commodities sector and infrastructural development in Africa. Bruatigam (2009) and Dent (2011) show that China's strategic interest in primary commodities in Africa drives it to invest in very difficult and politically unstable economies in Africa.

Kaplinsky (2010 and 2011) is among the few writers that hypothesise that the AD economies are capable of providing pro-poor technologies that are capable of tolerating the operating conditions in developing countries like Uganda. But in the absence of empirical investigation, this is only a hypothesis.

The original sources of diffusion of technology are changing with the rise of the Asian Drivers. This section outlines the relevant debates relating to the rise of what have become known as the 'Asian Drivers' – both the technologies (hard and soft) that originate from Asia and the impact that the countries themselves are having on Africa. As a result, the section also deepens the understanding of the term Asian Drivers.

2.3.1 Recognition of Asian Drivers as an important factor for African development.

This study defines the Asian Drivers (ADs) as China and India. I adopted the term Asian Drivers from a school of literature that looks at the economic impact of the growth of these countries on the rest of the world (see Chapter 1). The term Asian Drivers has been used to cover a range of countries in Asia including Korea, Singapore and Taiwan as well as China and India. In this thesis I focus only on China and India for two reasons (i) they provide the source of technology most used in the garment industry in Uganda and (ii) China and India are not classified as 'developed' economies as yet and therefore they provide an interesting example of south-south trade and collaboration not adequately addressed as yet in the literature.

The Asian Drivers' interaction with developing countries started gaining a lot of prominence in the early to mid-2000s, but the attention was mainly focused on their interaction with the Latin American countries and their trade and other connections with other Asian countries. Studies by Inter-American Development Bank (IADB, 2004), the UN Commission for Latin America and the Caribbean (ECLAC, 2005) and Spain's Blazquez-Lidoy *et al.* (2004) all focused on Latin American countries. Other studies such as Lall and Weiss (2004), Eichengreen *et al.* (2005) and Zhou and Lall (2005) focused on the impact of the Asian Drivers on other developing countries in Asia. Edwards and Jenkins (2005), Kennan and Stevens (2005), Brautigam (2009) and Kaplinsky (2010) are among the key pioneers of studies that explained the significant impact of the Asian Drivers on Africa. There have been no studies on the impact of the Asian Drivers on Uganda.

I. The rise of the Asian Drivers and their growing presence in Africa

Edwards and Jenkins (2005) show that the economic growth in AD economies has both positive and negative impacts on African countries. They argued that these impacts may be felt through foreign direct investment and trade. The positive impact may be due to the fact that African countries are able to more easily export to the Asian Driver economies. Similarly, outward investment flow from the AD economies may benefit African economies. As indicated above, FDI can be a very effective channel through which African countries can access technology. Thus, investments from the AD economies to African countries may come with both hard and soft technologies. The Asian Drivers may export the hard and soft technology to support their investment activities in Africa. They may also train the local employees in the firm on how to operate the hard technologies they use in their investments. In so doing, this creates local embedded capabilities.

Kennan and Stevens (2005) added that the impact of the Asian Drivers must not only focus on the competitiveness of Chinese cloth exports on African markets. They argued that emphasis must also be placed on the fact that they provide relatively cheaper cloths for African markets. Studies on the impact of the Asian Drivers on Africa's garment sector are mostly concerned with their indirect impact on trade, looking at the displacement of African exports to the USA and the EU (Morris and Einhorn, 2008, and Kamau *et al.* 2012). Although some studies have looked at the impact of the Asian Drivers on garments manufacturing in African economies, including through the provision of textiles which African firms transform into garments for export (Kaplinsky and Morris, 2008, Morris and Einhorn, 2008) and footwear (Tegegne-Gebre, 2006) no one has looked at their role in assisting African industry through the transfer of technology. Developing countries like Uganda may be able to import capital equipment from the AD economies for their production activities. These forms of technologies may be the type of technologies that developing countries were finding very difficult to access from their traditional partners—the European Union, North America and Japan

II. China and India as sources of technology for developing economies

I concentrate on China and India as AD economies because of the impact they are having / will have in driving the global economy and because they are playing an increasingly important role in Africa in general and in Uganda in particular. I am focusing particularly on the way in which they may become providers of technology which is appropriate for Africa. If I return to the discussion in Section 2.1.4 above on inducements to innovation, it can be seen that their technologies are potentially very relevant for Uganda and other African economies. The demand patterns in these AD economies are more like those in Uganda than are the demand patterns in the developed economies. Factor prices in the two AD economies (particularly low wage costs) are also more like Africa. The types of firms in the AD economies are often different from those in the developed economies, and they are introducing technologies in a situation of poor infrastructure, many illiterate users, low skills and poor communication channels.

For these reasons, the central questions in my dissertation are to analyse whether it is really the case that the AD technologies are different from those coming from developed economies. And, if this is true, what are the implications for growth and development? I have not found any other studies which look at these issues in detail especially not for Uganda. Some observers believe that the AD technologies are different and more appropriate (Kaplinsky, 2010), but do not provide any detailed evidence to support this belief. My study therefore looks at the role of the AD economies as a source of hard and soft technology for developing countries like Uganda. This study is concerned with sewing machines, other related garment making machines such as cutters and spares, that is, hard technologies. The soft technology represents the role of the AD economies as a source of cheap skilled labour and the expert (usually tacit) knowledge required to operate garment making machines and the organisation of production.

2.3.2 Which are the ADs in Uganda?

The discussion above focused on trade, FDI flows and the cross border flows of people from China and India as channels for their presence in Uganda. However, the presence of Asian-origin human skills and investment in Uganda has deep historical roots and there is a large presence of Indian-origin people operating in the Ugandan economy, and particularly in manufacturing. In my study I distinguish these long-term Ugandan residents of Asian origin from the AD actors who are the focus of this study. I do not consider these long-term Asian residents as representatives of AD actors in Uganda. Uganda has for many years had a human capital skills set that is of Asian (predominately South Asian/ Indian) origin. The nature of the human resource from China and India transferred in recent years is very different from that of the naturalised Ugandan-Asians. Indians have been living in Uganda since the pre-colonial era. They were brought into Uganda by the British colonial administration. They gained a lot of experience and skills and were contributing significantly towards the Ugandan economy. For example, by 1970 the Madhvani Group of companies was contributing almost 10 percent of the country's total revenue through corporate taxes and excise taxes. The Madhvanis were also employing more than 20,000 people (Ranja, 2003). However, in 1972, the then president of Uganda, Idi Amin ordered the expulsion of all Asians in Uganda. The departure of the Ugandan-Asians in Uganda led to their jobs and companies being given to indigenous Ugandans, resulting in many highly skills intensive companies being taken over by unskilled local labour (Tumuhairwe, 2012).

From the point of view of the economy, the expulsion of the Ugandan-Asians was a major negative event. Agricultural exports declined sharply since the Ugandan community at the time did not have the skills and capacity to produce more competitive products, look for markets and transport the goods abroad. For instance, by 1974 only 15 % of the total cotton produced in the country was processed (Baffes, 2009). Most of the existing machines were shut down due to lack of financial resources (see later discussion in Chapter 4 on the history of the Ugandan Asians).

Upon assumption of office in 1986, Yoweri Museveni made efforts to encourage the return of the previously expelled Ugandan-Asians. Many returned including the Madhavani Group. Currently, over 20,000 Ugandan-Indians are working and operating businesses in Uganda in almost all sectors of the Ugandan economy including manufacturing (Ancharaz *et al.* 2014). This policy led to an inflow of capital and more importantly played a very important role in the transfer of technologies (hard and soft) into the economy. This influx of hard and soft technology in the mid-1980s however occurred much earlier than the more recent influx of Asian Driver technologies being discussed in this thesis. By contrast the role of the AD economies as a recent source of hard and soft technology for developing countries is the resultant effect of their rise in technological capabilities. There is no evidence that the Ugandan-Asians played a role the development of technological capabilities in the AD economies and few of these Ugandan Asians have been involved as suppliers in the influx of AD technologies into Uganda. Thus, this study only considers the recent wave of AD expertise into Uganda as representing ADs and does not recognise the Ugandan Asian community as being part of this recent phenomenon.

2.4 A framework for analysing AD economies as a source of technology for developing countries

The primary objective of this dissertation is to test the hypothesis that the ADs are a new source of market-driven appropriate technology in Uganda with potentially very positive development and growth impacts. I will examine this through the lens of technologies in the garments sector in Uganda. In this chapter I have prepared the ground for the empirical analysis by first distinguishing between technologies and techniques. Techniques are specific applications of a technology, characterised by particular combinations of factor inputs and with specific infrastructure and skills requirements. In a broad sense, I describe technology as a collection of specific techniques.

I further discussed two forms of technology in this chapter—soft and hard technology. Hard technology considers the physical component of the technology (machinery and equipment). Soft technology consists of the skills, routines and organisation including management required to operate these hard technologies efficiently. Another important component of soft technology is knowledge. Available literature shows that there are two main forms of knowledge—the tacit and codified forms of knowledge. Tacit knowledge requires 'thinking technology' and cannot be easily expressed in a written form and it is difficult to present it in a formal and standardised form. Again, acquisition of tacit knowledge requires a certain level of mastery and face-to-face interaction. Codified knowledge describes the written and documented form of knowledge. It is also one of the reliable ways of passing knowledge to those who can read.

I also noted in this chapter that there is no Darwinian inevitable path for technical change. This means that there are alternative sets of techniques and these techniques result from the inducement factors in the environment in which they are developed. The hypothesis is that this environment in developing countries such as the AD economies is more likely to produce technologies appropriate for Uganda than those coming from the developed economies. This is based on the assumption that AD technologies are less capital intensive, more labour intensive, simple and less skills intensive, tolerant to weak infrastructure, and operate at a lower scale.

I further identified three channels whereby these technologies from the AD economies are transferred to Uganda. There are three channels in which the AD technologies can be transferred to Uganda – trade, FDI and through flows of people – encompassing both hard and soft technologies. Trade is the easiest means of technology transfer and involves the movement of machineries and intermediate inputs from the country of origin of the technology to the recipient country. As noted above, there are a variety of AD actors in Uganda, but these do not include the Asian origin long-term Ugandan residents (most of whom are Ugandan citizens). This is mainly because there is no evidence to show that the Ugandan Asians played a role in the rise of the AD economies as a source of technologies for developing countries. However as discussed above, I recognise the fact that the Ugandan-Asian also play a very significant role in the transfer of technology into Uganda.

Based on these assumptions, I provide a matrix in Table 2.1 to draw together these relevant elements for analysing the AD economies as a source of garment technology for Uganda. This framework is outlined in the form of a 2 X 2 matrix in which the role of each AD economy (China and India) as a source of hard and soft technology is analysed. I add another level to the 2 x 2 matrix to analyse the AD economies' channel of interaction with developing countries like Uganda. This additional level of detail relates to the fact that the literature has highlighted trade, FDI and cross border movement of personnel as important channels through which developing countries like Uganda will be able to access technologies from the AD economies.

Table 2.1: Framework for analysing Asian Drivers as a source of technology

AD Country	Channel of interaction	Hard Technology	Soft Technology
China	Trade	A	G
	FDI	B	H
	Cross Border Movement of Personnel	C	I
India	Trade	D	J
	FDI	E	K
	Cross Border Movement of Personnel	F	L

Source: Author's proposed framework

I will come back to this matrix and populate the cells A to L in Chapter 10. This analysis will enable me to assess (i) whether the AD technologies (hard and soft) are diffused through a variety of technology transfer channels, and (ii) whether involving, to different degrees, actors from China and India will contribute to growth and development in Uganda. In Chapter 3, I will discuss the conceptual framework and how data was collected for this study. The conceptual framework will discuss the research questions in relation to all the assumptions related to this study. I will also discuss the methods, nature of respondents and procedures for collecting data.

CHAPTER 3: CONCEPTUAL FRAMEWORK AND METHODOLOGY

3.0 Introduction

In the previous chapter, I discussed the theoretical context in which this dissertation is framed. Based on this theoretical framework, I revisit the main research questions that this study sets to answer. Second, I discuss the research methods and instruments for data collection used in line with the focus of the study. The third part of the chapter explains the methods used for data analysis. Fourth, I discuss ethical guidelines that were adhered to in this study.

3.1 Conceptual framework for the study

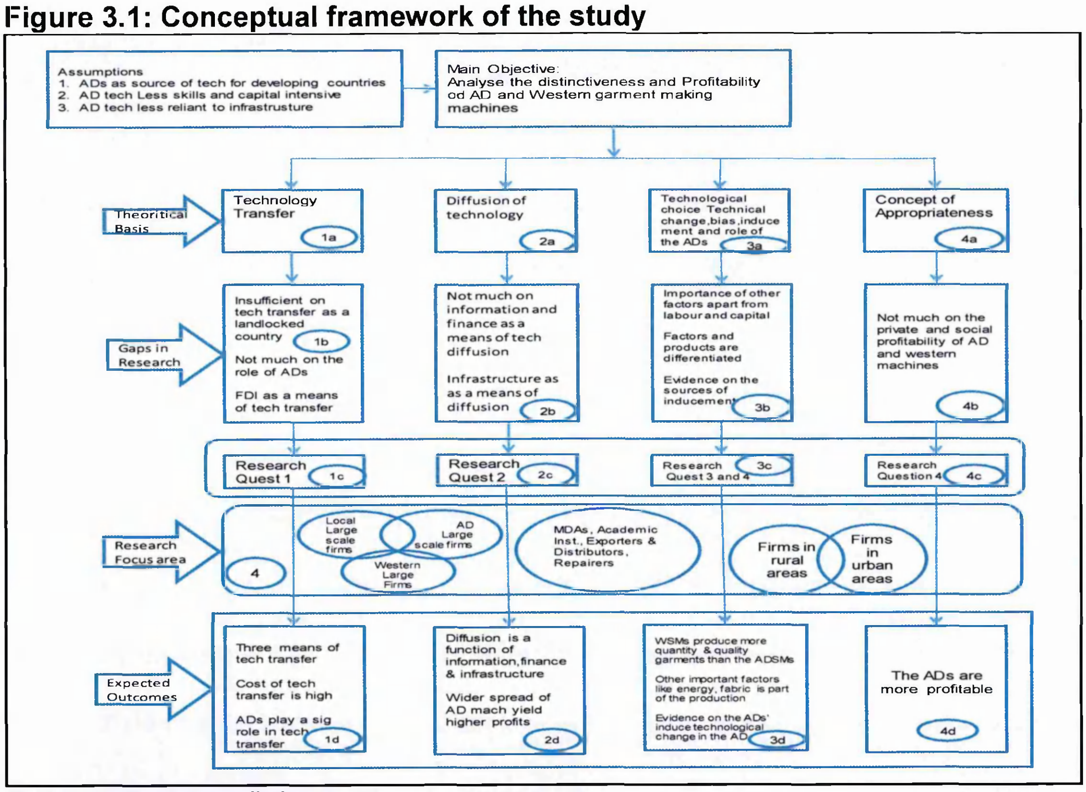
In Figure 3.1 below, I present the conceptual framework of this study. It summarises how I aim to answer my research questions, based on the research gaps I have identified. The conceptual framework also presents a summary of the expected outcomes of this research.

3.1.1 Summary of research assumptions

As mentioned in Chapter 1 above, this research primarily aims to examine the distinctiveness and profitability of AD and Western garment making machines in Uganda. This objective is achieved based on the assumption that the very large size of the AD economies coupled with their growing technological capabilities is likely to make them major sources of innovation for low income consumers (Figure 3.1). These technologies from the AD economies are hypothesised to be labour intensive, tolerant to poor infrastructure, operate on small scale and less capital and skills intensive (Kaplinsky, 2010) (Figure 3.1). This comes in the wake of growing demand for low cost technologies by low income earners in developing countries (Kaplinsky, 2010). Developing countries over the years have been facing difficulties accessing technologies from Western economies. Technologies from the west have been recognised to be capital and skills intensive, tolerant to environment where infrastructure is more pervasive and produce products for high income consumers

(Stewart, 1982, Bhalla 1985, Kaplinsky, 1990 and 2010). To be able to compare technologies from these two different sources—AD and Western economies—I build this research on the theories of hard and soft technology, choice of technique, technical change, bias, inducement, appropriate technology, technology transfer and the rise of the AD economies as discussed in Chapter 2. I draw on these theories to determine how these validate (or otherwise) the above assumptions and contribute to filling the research gaps I identified in each of the theories in Chapter 2.

Figure 3.1: Conceptual framework of the study



Source: Author's compilation
NB: ADSMs means Asian Driver Sewing Machines, WSMs means Westem sewing machines.

The gaps that were filled in literature provided answers to the following research questions:

1. How is garment equipment from the AD and Western economies transferred to Uganda?
2. Does the level of distribution of the AD garment equipment differ from those of the Western ones in Uganda?

3. How distinctive are AD and Western garment equipment in developing countries?
4. Does the degree of profitability of AD garment equipment differ from those from the Western economies?

I discuss my research assumptions in a little more detail below.

Research Question 1: How is garment equipment from the AD and Western economies transferred to Uganda?

I answered research question 1 by premising the study on the theory of technology transfer (see 1a of Figure 3.1 below). The study considered the transfer of both the soft and hard components of technology. The study assumes that international trade, FDI and cross border movement of personnel is the three most important modes of hard and soft technology transfer. It also assumes that the AD economies play a crucial role in the transfer of hard and soft technology into Uganda. I further assume that the cost of soft technology transfer from an AD economy will be relatively less expensive compared to a Western economy.

International trade involves the transfer of machinery and intermediate products from its country of manufacture to a recipient country (Wahab *et al.* 2012). However the cost of the transfer process varies according to the location of the receiving country (Faye *et al.* 2004). The cost of transport for a landlocked country is higher than that of a maritime country. FDI serves as a means of transferring both the hard and soft technology to developing countries (Faye *et al.* 2004). Thirdly cross border movement of personnel serves as a means of transferring experts to receivers of technology (Maskus, 2004).

Gaps identified in the technology transfer literature

The technology transfer literature has not paid much attention to the cost involved in the transfer of hard and soft technologies into landlocked Uganda. Available studies mainly pay attention to trade policy and transport cost (Faye *et al.* 2004 and UNCTAD, 2013) (1b of Figure 3.1). Also FDI from the AD economies has mainly concentrated on primary commodities and infrastructure (Farooki and Kaplinsky, 2012, Dent, 2011 and Brautigam, 2009) but not technology transfer into the manufacturing sector (1b of Figure 3.1). Lastly, the role of the AD economies as a means of transferring technology is not adequate in literature (see 1b of Figure 3.1).

Expected outcome

I expect that FDI, international trade and cross border movement of personnel will be identified as important modes of hard and soft technology transfer into Uganda. I also expect that the AD economies will play a very important role in the transfer of technologies into Uganda (see 4d of Figure 3.1). Furthermore, the cost of transferring technologies to Uganda is expected to be higher than that of the country's maritime neighbours.

Research Question 2: Does the level of distribution of the AD garment equipment differ from those of the Western ones in Uganda?

This question was answered based on the diffusion literature (2a of Figure 3.1). I assume that the rate of diffusion of the AD garment making machines and its related soft technologies is faster than that of the rate of diffusion of machines from the Western economies. I also assume that the spread of the AD hard and soft technologies is wider in rural communities than in urban communities. I also assume that diffusion of soft technology from an AD firm will be cheaper and easier than that of a Western firm in Uganda. I further assume on-the-job training to be one of the important ways of acquiring soft technology in the Ugandan garment sector. Diffusion is the process through which an innovation is communicated through a social system (Rogers, 2003). Technology transfer and diffusion are complementary. A transferred technology cannot be useful if it is not well diffused and adopted (Rogers, 2003). The speed of technology adoption is determined by the cumulative frequency of acceptance of the technology. Thus, adoption rates vary from one individual to another. A well-resourced adopter may be able to adopt a technology faster than a less resourced adopter.

Gaps identified in the diffusion literature

The diffusion literature recognises the relevance of information as a means of diffusing innovations (see Roger, 2003, Blackman, 1999, and Comin and Hobijn, 2010) but this does not focus on specific sectors like the garment sector (2b of Figure 3.1). The literature also identifies finance as an important variable for diffusion (Comin and Nanda, 2014 and Spolaore and Wacziarg, 2011). Studies available place more emphasis on financing Western technologies. Technologies from other developing countries like the AD economies have not been given much priority in the literature (2b of Figure 3.1). These studies also recognise the well-developed financial institutions in the Western economies as the source of finance and not those in developing countries like Uganda (2b of Figure 3.1). Furthermore, differences in infrastructure also influence the nature of distribution. A hard technology that uses electrical energy cannot be adopted by adopters who are based in rural areas where there is no electric power. Not much evidence has been provided in literature to support this assertion (2b of Figure 3.1). The diffusion literature is further silent on the relationship between the spread of the technology and profitability.

Expected outcomes

I expect that information, finance and infrastructure requirement will emerge as important issues impacting diffusion of garment making machines in Uganda (4d of Figure 3.1). I also expect that the spread of the AD garment making machines to be wider than the Western ones—particularly in areas where there is no electricity (2d of Figure 3.1). Relative to the Western garment making machines, I also expect that the extent of spread of AD garment making machines will reflect their levels of profitability.

Research Question 3: How distinctive are AD and Western garment equipment in developing countries?

I assume that the AD garment making machines are more pro-poor compared to the Western machines. I compare the pro-poor nature of the AD and Western garment making machines by considering indicators such as the level of capital required, reliance on energy infrastructure, skill requirements and accessibility. I also assume that the AD garment making machines are easier to repair than the Western ones. This is because the AD machines are assumed to be less sophisticated intensive than the Western made machines. These assumptions are validated or otherwise by relying on the soft and hard technology, choice of technology, technical change, bias and inducement literature (3a of Figure 3.1). With regards to the theory of technological choice, as discussed in Chapter 2 the neoclassical assumption considers only two factors (i.e., capital and labour) in the production function but there are other important factors that need to be considered in making a choice (Stewart, 1982, Kaplinsky, 1990, Kaplinsky, 2010 and 2011). Arguably, other factors such as energy, intermediate inputs and services need to be considered (3a of Figure 3.1). This study seeks to provide evidence to show the importance of these neglected factors in the production function. Again, the neoclassical approach also assumes that factors are homogeneous (Stewart, 1982, Kaplinsky, 1990, Kaplinsky, 2010 and 2011). This study assumes that factors are differentiated. Opponents of the neoclassical assumption like Eckaus (1955) and Emmanuel (1982) indicate that efficient technologies only originate from Western economies. This study provides evidence to rebut this assertion in literature by showing that there are other sources of technologies—from the AD economies; again another assumption that this thesis assumes is wrong.

Gaps in Literature

Not much has been done to show that there are other important factors that need to be considered in making a choice of which technology to adopt and utilise. Only a few studies such as Stewart (1982) and Amsalem (1983) have addressed this issue. Arguably, other factors such as energy, intermediate inputs and services need to be considered (3a of Figure 3.1).

Expected Outcome

This study adds to literature by providing evidence to show the importance of these neglected factors in the production function. I also provide evidence to show that factors are differentiated and not homogeneous. More importantly, not much study has been done to show other sources of technologies. This study provides evidence to rebut this assertion by Eckaus (1955) and Emmanuel (1982) by showing that there are other sources of technologies—from the AD economies. I expect the AD garment making machines to be less reliant on infrastructure compared to those from the Western economies. I also expect the AD garment machines to be less capital intensive and less durable compared to those from the Western economies. Furthermore, the AD garment making machine is expected to be less skill intensive and produce fewer quantities of garment compared to those from the west. The quality of garment produced by the Western garment making machines is expected to be of higher quality compared to those produced by machines from the AD economies.

Research Question 4: Does the degree of profitability of the AD garment equipment differ from those from the Western economies?

As indicated in Chapter 2 above I indicated that technologies that are appropriate for developing countries are often considered to be less capital intensive, less reliant on infrastructure and easier to access (4a of Figure 3.1). In addition, the technology should be able to use resources available to produce an output that will yield a certain level of profit for the garment producer. I assume that machines with these properties may be more profitable in developing countries. I also assume that the location of the garment making technologies influences the level of returns that will be accrued as a result of using the sewing machine.

Gap in Literature

Measuring the profitability of machines has not been given attention in available literature. Stewart (1982) and Bhalla (1985) are among the few studies that undertook studies on this. However, Stewart and Bhalla did not specifically focus on the profitability of garment making machines.

Expected Outcome

I expect that the AD garment making machines will be both privately and socially more profitable than the Western ones (4d of Figure 3.1). I also expect the location of the garment making machine to play a crucial role in the level of returns of the technology. Furthermore, I expect that the AD technologies will create more jobs compared to the Western technologies.

3.2 Summary of the research focus area

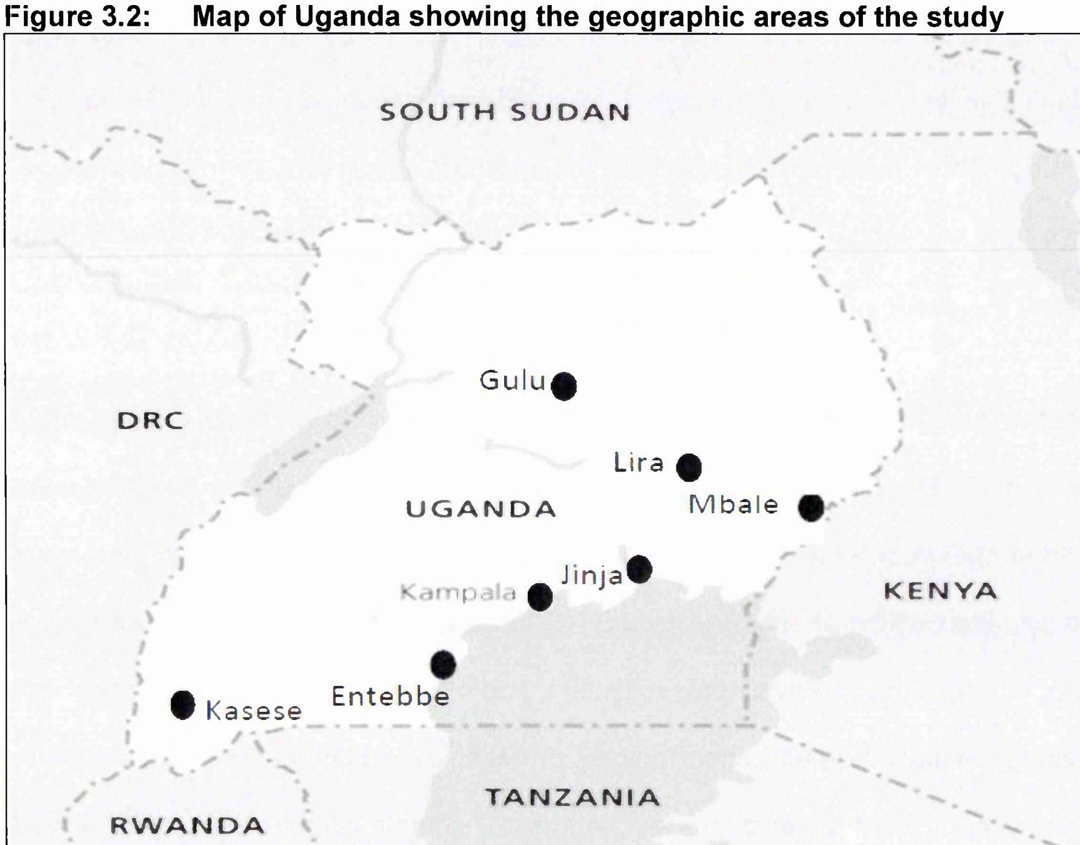
This study researches these assumptions and research questions by focusing on the Ugandan garment making sector. The reason for this choice of sector is because of its significant importance in job creation, income distribution and ultimately poverty reduction as outlined in more depth in Chapter 1. Specifically this research focused on both large and small scale garment making technologies. There are three types of garment-making technologies—(1) those bearing Western brands and originally manufactured in a Western country; (2) those bearing a Western brand but manufactured in an AD country; and (3) those manufactured in an AD country with an AD brand. This study focused on technologies manufactured in an AD economy and also bearing an AD brand; as well as those that were manufactured in Western economies and also bearing a Western brand. These technologies were analysed in the context of the location and size of the garment firm.

The small scale firms were concentrated in both urban and rural communities. Large scale firms were only present in urban areas. At the large scale level, the study considered industrial garment making machines and small scale garment making machines were considered at the small scale level (Figure 3.1 above). At the large scale level, I focused on machine operators in the AD, Western and local large scale garment making firms. However, the small scale garment making firms were mainly the informal small scale garment producers. Key informants from academic institution, and MDAs were also considered.

3.2.1 Geographic area of research

Uganda is made up of 112 districts and three important cities— Jinja, Kampala and Entebbe. In addition to the three cities, the study focused on 4 other district capitals namely Mbale in the Eastern region, Kasese in the Eastern region, as well as Lira and Gulu districts in the Northern region. Furthermore, the study located five more rural communities that are within 50 km radius from their respective district capitals for the study. The rationale for selecting the three capital cities and districts is that they represented the industrial hub of Uganda. They were also selected because they were relatively safer and easier for me to collect data for my research work. Figure 3.3 shows the geographic locations of the capitals and districts in Uganda.

Figure 3.2: Map of Uganda showing the geographic areas of the study



Source: Ugandan Bureau of Statistics, accessed April 4, 2013

3.3 Research methodology

This study uses the mixed methods approach to collect data required to answer the above research questions. Mixed methods was chosen as the primary methodology because it enabled me to interrogate the subject area in an intensive manner; enabling me to get behind the figures and understand more concretely why and how AD garment making technologies impact on the Ugandan textile industry and poverty reduction efforts.

Mixed methods refer to a mixture of qualitative and quantitative research methodologies (Teddlie and Yu, 2007). Quantitative method primarily explains the phenomenon of collecting numerical data for mathematical analysis (Aliaga and Gunderson, 2000). This involves tangible measurements including representative sampling, numerical and hard data for testing theory and generalising findings (Bryman, 2004 and Antonius 2003). Secondary data and experiments are also used for quantitative research (Antonius, 2003, and Woodhouse, 1998). It focuses mainly on secondary and primary data which are usually collected through surveys. I collected both secondary and primary data for this study. The primary data was collected through a survey and interviews. I will discuss how the secondary and primary data were collected in more detail in Section 3.4.1 and 3.4.3 respectively.

Qualitative research on the other hand uses data that do not indicate ordinal values (Nkwi *et al.* 2001). This generates a strong interactive link between the object of study and researcher in order to generate findings that are mutually created within the context of the situation which shapes the inquiry (Guba and Lincoln, 1994, and Denzin and Lincoln, 2000). This involves the collection and/or working with text, images, and sounds. Qualitative research often focuses on techniques such as in-depth and group interviews, participant observation, text, images or sounds. Other instruments for data collection in qualitative research include observation, ethnography, content analysis as well as interviews (Wellman, 2001, Bless, 2000 and Berg, 1998). I conducted face-to-face interviews with key informants in the garments sector. These key informants span from garment making machine operators to experts in MDAs. I will provide details on how I conducted the interviews in Section 3.5.3. Though there are practical differences between the two methods, there is practical evidence to show that "social scientists are likely to exhibit greater confidence in their findings when these are derived from more than one method of investigation" (Bryman, 1988).

3.4 Research methods and data collection

As indicated above, I used both quantitative and qualitative methods to collect data for this study. This study considers surveys and interviews for the primary data collection. I will discuss these in detail in Section 3.4.3. I first started with the collection of secondary data for this study.

3.4.1 Collection of secondary data

The first stage of the data collection started with archival research to understand the state of the Ugandan economy with particular emphasis on garment-making technologies in the manufacturing sector. The archival research was based on international databases such as World Development Indicators, World Integrated Trade Solutions (WITS) of the World Bank, official government document reports and other academic publications. Some of the official government reports that were used include the Uganda 2012 Statistical Abstract (GoU, 2013), projections of demographic trends in Uganda 2007-2017 (GoU, 2010), the Uganda National Textiles Policy (GoU, 2009) and the Uganda Industrial Policy (GoU, 2008). These archival documents provided detailed time series data on the key sectors of the economy. This encapsulates key macroeconomic data on poverty, employment, foreign direct investment as well as trade in garment-making technologies.

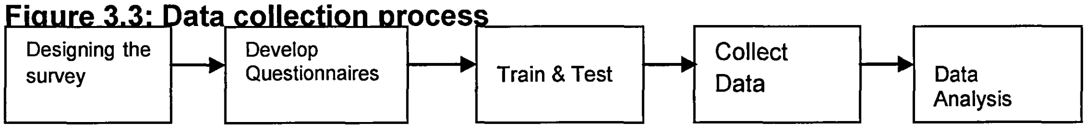
3.4.2 Challenges encountered in the secondary data collection

I had problems accessing archival data from official documents in Uganda. This was generally due to the lack of proper record keeping. In some cases, the data available from a variety of sources was often not up to date. Again, data requested from the MDAs in Uganda were not forthcoming. In addition, cross checking some of the data from different sources gave different figures and so it was very difficult to use them for any meaningful analytical work. Furthermore, some of the Ugandan officials were very wary as to the type of data to give out. In view of that most of the data were obtained from the international sources—the databases of World Integrated Trade Solutions (WITS) and World Development Indicators (WDI). The challenge with the international databases was that the data points were uneven and not well updated in some cases. For instance, infrastructure data on roads, energy, income distribution etc, were absent in the international databases.

3.4.3 Primary data collection

The second stage of the data collection was the main field research conducted in Uganda between July 2012 and February 2013. A general survey was conducted to ascertain the diffusion, distinctiveness and profitability of AD and Western garment-making technologies in Uganda. A general survey is a data collection instrument used to collect data from an identified sample frame (Antonius, 2003 and Scheuren, 2004). This started with a design of the survey process through questionnaire development to data analysis (Figure 3.3 below). The survey was administered to 147 small scale garment producers, 18 employees in 11 large scale garment making firms and 20 importers and distributors of garment making machines in Uganda (Table 3.1). Respondents at the small scale level were mainly garment firm owners who operate small scale garment making machines. All the surveys I conducted were on a face-to-face basis. The data collection instrument I used for the survey was a semi-structured questionnaire.

Figure 3.3: Data collection process



This was followed by face-to-face interviews with 10 experienced small scale garment producers and four large scale garment producers. In addition, six key informants from MDAs, two garment and textiles experts in academic institutions (Makerere University and Kyambogo University) and five garment making machine repairers were interviewed (Table 3.1). In all, I interviewed 27 key respondents in the garment sector in Uganda. The surveys and interviews I conducted provided detailed information on the characteristics of the respondents, the role of the AD economies as a source of hard and soft technologies in Uganda, the origin, nature and type of garment making machines used for garment production in Uganda (Table 3.1).

Table 3.1: A matrix of data that was collected in the Ugandan garments sub-sector

		Small Scale Firms	**Large Scale Firms**	**Ministry Department & Agencies**	**Academic Institutions**	**Importers& Distributors**	**Machine Repair Shops**
Type of Respondents		Garment producers & Machine Operators (tailors & seamstresses)	Machine Operators Manager, Engineers	Experts in the garment industry and trade	Experts in the garment industry & trade	Managers, Retailers & Wholesalers	Machine Repairers
Gender	Male	63	10	4	2	18	5
	Female	84	8	2	0	2	0
	Total	**147**	**18**	**6**	**2**	**20**	**5**
Nature of ownership	Firm owner	137	3	0	0	2	5
	Machine operator /Employee	10	15	6	2	18	0
	Total	**147**	**18**	**6**	**2**	**20**	**5**
Location of interview by region	Central	52	18*	6	2	20	5
	Northern	26	0	0	0	0	0
	Eastern	36	0	0	0	0	0
	Western	33	0	0	0	0	0
	Total	**147**	**18**	**6**	**2**	**20**	**5**
Interview Date		01/09/2012-20/01/2013	01/11/2012-15/12/2012	01/10/2012-30/01/2013	01/10/2012-30/01/2013	15/11/2012-20/12/2012	15/11/2012-20/12/2013
Sampling method		Simple Random Sampling	Purposive	Purposive	Purposive	Purposive	Purposive
Data collection		A survey using semi-structured questionnaire (see Appendix II)	Survey using semi-structured questionnaires (see Appendix II)	Interviews using semi-structured questionnaires (Appendix III)	Interviews using semi-structured questionnaires(Appendix III)	Survey using semi-structured questionnaires (Appendix I)	Interviews using an interview guide (Appendix IV)
Research Question		2, 3 and 4	2, 3 and 4	1	1,2 and 3	1	3 and 4

*Source: Author's fieldwork compilation, *all the respondents in the large scale firms were interviewed in Jinja and Kampala, Central region of Uganda-see also Table 6.3.*

Thus in summary, the primary population for the study are as follows: (I) operators of garment-making technologies in small scale firms, (II) operators of garment making machines in large scale firms, (III) importers of garment-making technologies at both small and large scale levels, (IV) key respondents at the MDAs, (V) academic institutions and (VI) machine repairers (Table 3.1). The next section shows how data was collected to answer each of the research questions.

3.5 Data collection for each research question

This section explains how the data was collected to answer each of the research questions. This section also explains the sampling approaches that were used for the study. It also describes where the data was collected for each research question. The data collection instrument is mainly semi-structured questionnaires. I also used an interview guide for one group of respondents—machine repairers.

3.5.1 Research questions one and two

Data on distribution and mode of transfer of capital equipment in the sub-sector were obtained from the point of importation and distribution, as well as the end users. The study employed the purposive sampling approach to sample importers and distributors of capital equipment in the sub-sector. Purposive sampling is a type of non-probability sampling approach where individuals are selected because they are the most representative of the population (Levy and Lemeshow, 2008). The importers are very busy and few in Uganda. Therefore using this approach enabled me to sample the importers with the requisite knowledge on garment-making technologies in Uganda.

According to the Uganda Clearing Industry and Forwarding Association, there are a total of 102 registered importing firms that are involved in the importation of garment making machines in Uganda. Out of this total number, 20 of them were sampled for this study. These importers also doubled as distributors. As distributors, they have retail and wholesale outlets where they transport their machines for onward sales. I conducted the survey with either owners or managers of each importing firm using semi-structured questionnaires (Appendix I). Each survey lasted for an average of 60 minutes. Respondents' responses were also recorded and transcribed for detailed analysis.

3.5.2 Research question three

Question three poses the question: how distinct are AD garment-making technologies relative to those from the Western economies? This question required that the fieldwork concentrate on producers of garments both at the large and small scale levels as well as machine repairers and experts at the MDAs.

I. Small scale manufacturers

Data collection on small scale garment producers took place from September 1, 2012 to January 20, 2013. At the small scale level, the study used the random sampling approach to sample 147 small scale garment making firms in the Ugandan garment sector (Table 3.1). This sampling approach gives equal chances of selecting each sampling unit (Bechhofer and Patterson, 2000). I obtained the list of registered garment producers from the Ugandan Ministry of Trade, Industry and Cooperatives (MTIC). This was a compiled list of garment producers who were part of the MITC's cooperative union. This list contains registered members across all the four regions of the country. The total list of registered garment producers on the list that was given to me was 594 in total. According to key informants at the MITC, this list forms the core members of professional small scale garment producers in Uganda. I am aware that there are a lot of small scale garment producers in Uganda who may not be registered members of MITC's small scale garment producers. However, due to limited resources available to me I decided to rely on the list that MITC served me.

I started by randomly selecting the 4th registered member as the starting point for the sampling. I then selected every fourth person on the list until I had moved through the list. A total of 147 garment producers were sampled at the small scale garment production level for this study. 63 of them were male and 84 were female and almost all of the small scale garment producers (147 respondents) were single entrepreneurs—sole proprietors and/or owners of the garment making machine they use (Table 3.1). In addition, the majority of the surveys were conducted in Entebbe, Jinja and Kampala (52 respondents) (Table 3.1). I also conducted the survey in the Eastern (36 respondents), Western (33 respondents) and Northern (26 respondents) regions of Uganda (Table 3.1).

Using the 'face-to face' approach, respondents were asked a list of questions using semi-structured questionnaires (see Appendix II). Each questionnaire I administered to a respondent lasted for an average of 60 minutes and was recorded. The questionnaire contained questions pertaining to energy requirements, frequency of breakdown, the quality and quantities of garments produced by the AD and Western garment making machines.

II. Large scale manufacturers

According to the Ugandan Investment Authority (UIA), there are 35 large scale garment-making firms in Uganda. The study purposively sampled 11 out of the 35 large scale firms[2] for the study (Table 3.1 above). The 11 large scale firms were chosen because they were the most accessible for the survey. In each firm, I purposively sampled at least one respondent in the large scale firms I considered for the study. The respondents I sampled are mainly employees and they included senior staffs—managers and engineers—and junior staffs—machine operators. In all, I conducted the survey on 18 large scale garment producers and these respondents were all located in the central region, particularly Jinja and Kampala. The survey was conducted between 01/11/2012 – 15/12/2012 (Table 3.1).

I administered semi-structured questionnaires (Appendix II) to the respondents I sampled. In total I administered the semi-structured questionnaires to 18 respondents of the large scale firms. Each survey I conducted lasted an average of 60 minutes. Responses from the respondents were recorded. The machine operators at the large

[2] Later in Chapter 6 of this study, I will discuss in detail the sources of technology, size of firm as well as the time of establishment of the firm.

scale level were casual wage employees. The survey focused on the properties of the AD and Western garment making machines. The respondents were sampled in only urban communities considering the fact that all the large scale firms in the country are based in urban communities.

3.5.3 Research question four

This question asked: Does the degree of profitability of the AD capital equipment differ from those from the Western economies? In order to answer this question, I purposively sampled four most experienced machine operators out of the 18 respondents for face-to-face interview. The key respondents at the large scale level were mostly the senior machine operators, supervisors, and directors of the company. I further sampled 10 most experienced machine operators at the small scale level using a purposive sampling approach. Each face-to-face interview lasted for an average of 90 minutes. The duration for these interviews was long because the key respondents were requested to answer the interview questions with illustrations using the sewing machine. I focused my questions on 20 sewing machines (10 AD and 10 Western sewing machines) to gain in-depth machine data for the purpose of measuring the profitability of the sewing machine. This was done with the assistance from the experienced machine operators. The sampled garment making machines were all in similar conditions. Profitability indicators such as output levels and cost of labour (i.e. machine operator), energy, fabric, transport etc were considered for the profitability measurement (see Chapters 7, 8 and 9 for details). These detailed interviews were recorded and transcribed. I used sections of the semi-structured questionnaires in Appendix II (i.e. Sections B to I) as the data collection instrument. The focus at this stage was for the experienced garment producers to explain in detail how the nature of the garment making machine affected their profitability levels.

I. Ministry personnel and other stakeholders

The study also purposively sampled experts from the Ministries, Departments and Agencies (MDAs) and academics institutions to ascertain the role of government and other institutions in the garment industry. Two key respondents were sampled from academic institutions and six from MDAs. The academics interviewed were professors from Makerere University and Kyambogo University. The respondents from the MDAs were senior staffs. These persons were chosen because they have several years of experience and knowledge in garment and textile technology. In addition, they played important roles in drafting the garment and textiles policy document. I conducted a face to face interview with all the experts I purposively sampled. Each interview lasted for 60 minutes and was conducted using a semi-structured questionnaire (Appendix III). Respondents' responses to the questions were recorded and transcribed for a more in-depth analysis. The experts who were interviewed are all located in the Central region—Kampala. Two of those who were interviewed in the MDAs are female. The rest of them (including those from academic institutions) are male. The interviews asked for information relating to the challenges associated with the transfer of soft and hard technology, the role of the Asian Drivers and government in the garment sector.

I. Sewing machine repairers

Five sewing machine repairers (all Ugandan Africans) were purposively sampled for this study. I sampled these machine repairers mainly because they were accessible and had the relevant experience in repairing garment making machines. All the machine repairers I interviewed were male repairers and they were located in Kampala in the Central region of Uganda (Table 3.1). I interviewed the machine operators using an interview guide (Appendix VI). The interviews were conducted in a face to face manner and each interview lasted an average of 45 minutes. The interviews were recorded and transcribed. The interview gained information on the durability of the AD and Western garment making machines. I also investigated the differences in skills requirement for repair works for the two alternative garment making machines. Table 3.2 below presents a summary list of the categories of respondents who were considered for the primary data collection. Table 3.2 also shows the type of data collection instruments and their appendix numbers.

Table 3.2: List of data collection instruments I employed for the study

Categories of respondents	Type of data collection instrument	Appendix No.
Importers and distributors of garment making machines	Semi-structured questionnaire	Appendix I
Small and large scale garment producers	Semi-structured questionnaire	Appendix II
Key informants in small and large scale garment firms	Sections B to I of appendix II Semi-structured questionnaire	Appendix II
Key informants in MDAs and Academic institutions	Semi-structured questionnaire	Appendix III
Machine Repairers	An interview guide	Appendix IV

Source: Author's own compilation

3.5.4 Challenges during the primary data collection

Acquiring a research permit in Uganda was very challenging due to the long bureaucratic processes that I had to go through. I was required to obtain a research approval from the office of the President through the Uganda National Council for Science and Technology before conducting research in Uganda. Consequently, I spent six weeks to complete the processing of the documents. This was after I have been accepted as a Research Associate at the Economic Policy Research Centre; University of Makerere. This led to a late start of the research work in Uganda.

This study didn't just investigate the impact of AD economies in terms of the hard technologies such as sewing machines they provide to the garment making industry in Uganda. As I indicated in Chapter 2 above, the AD economies also provide a significant number of skilled individuals to the industry too. In fact, the presence of garment producers from the AD economies owning or working in firms at the large scale level was significant; but limited access to their firms made it difficult for me to sample respondents for the study. As a result I was only able to interview a few AD respondents in the sector. This was because they lived in closed communities and are security conscious. Despite the fact that these individuals are foreigners, they are not oblivious of Uganda's history of expelling the Ugandan Asians in the 1970s. As indicated in chapter 2 above, here I am not referring to Ugandan Asians but to migrants from China and India who have come from the Asian Driver economies to Uganda in recent years to work.

3.6 Data analysis

As I have indicated earlier, all the conducted interviews were recorded using an audio recorder. At the end of each interview, the recorded interviews were transcribed, coded, and thematically organised. The coding and thematic organisation of the data aims at categorising and sorting the data for analytical purposes (Bryman, 1988). These two processes also link the diverse observations and statements from respondents by common themes and patterns for the purposes of answering the above research questions (Bryman, 1988). The key themes that emerged from data were as follows: 1. The sources and mechanisms of transfer of garment making technologies into Uganda; 2. The role of the AD economies in the transfer of hard and soft technologies into Uganda; 3. The distinctive characteristics of an AD and Western garment making machine; 4. The role of government in the garment sector in Uganda.

In addition, there were picture illustrations to show the differences between the garment making machines from the AD and Western economies. These pictures were taken from various sources; this includes garment making firms, wholesale and retail shops. These pictures were used to illustrate the various characteristics of the AD and Western garment making machines. Studies such as Collier and Collier (1986) attest to the importance of photography in unpacking the complex characteristics of a subject in qualitative research. After that the findings from both the quantitative and qualitative data were transposed into the study in the context of the research questions. The quantitative data that was collected using semi-structured questionnaires was captured using Statistical Package for Social Sciences. The quantitative data was used to undertake simple descriptive statistical analysis such as graphs and frequency tables.

In addition, in-depth case studies were prepared to provide a true picture of what pertains on the field. Three firms were purposively sampled for the case study. These were the Crane Bank and Kwera Garment both located in Kampala, and Sigma Knitting located in Jinja. In general, I purposively sampled these firms because of their easy access. These case studies also demonstrated the inclusive nature of the AD garments making machines. For instance, I sampled Kwera Garment to show how the use of AD garment making machines kept Kwera Garment competitive in garment production in Uganda. Sigma Knitting was also considered to show the easiness of diffusing soft technologies from the AD firms to the local market at no cost. I also chose the Crane Bank to demonstrate how the low cost nature of the Asian Driver garment making technologies is inducing financial institutions to finance garment technologies imports from the AD economies.

3.7 Research ethics

In designing research work, there is the need to adhere to strict ethical guidelines to ensure that the rights of the respondents are both protected and respected. Therefore it is important to alert the respondents about the rationale and potential consequences of the study. It is also necessary to seek the consent of the respondents before conducting an interview. The respondents must also be assured of a guaranteed confidentiality and protection from any harm (Bryman, 2004 and Antonius, 2003). This study followed the ethical guidelines of the Open University from which it obtained an ethical approval in February 2012 (Appendix V). I followed instructions in the approval letter to prepare a consent form (Appendix VI) which was used during the data collection. This was to make respondents aware of the background and objectives of the study and also to seek their consent.

The letter requested the respondent's' consent of participation, and provided the contact details of the researcher and those of the supervisor's in case respondents needed further information about the study. The letter further sought the consent of the respondent to tape record the interview and use the information collected as part of the final research product by signing the consent form (Appendix VI). The consent form was further used to assure the respondents of confidentiality of all responses that they will give. This involves omitting names or replacing them with code names. The approved letter also promised respondents that no recorded information which identified them will be disclosed to the public but will strictly be used for research purposes. Again, the letter indicated that they were not required to answer questions if they are not prepared. They could choose to withdraw from the interview at anytime without being compelled.

3.8 Conclusion

This chapter has discussed the conceptual framework, research methodology and methods of the study. I also discussed the data collection instruments that were considered for the various stages of the research process. I further discussed how ethical issues were addressed during the data collection process. The chapter further described how the data collected was analysed. I collected data from machine operators, importers and distributors, machine repairers, a financial institution, experts in the MDAs and academic institutions. I used both quantitative and qualitative data collection methods in the collection of the data. The quantitative data was collected by first collecting secondary data from online databases such as WITS and WDI; followed by a survey. The collection of qualitative data was achieved by conducting in-depth face-to-face interviews with key respondents. The next chapter of this study describes the Ugandan economy and the state of the garment sector in the country.

CHAPTER 3 : UGANDA AND ITS GARMENT AND TEXTILE SECTOR

4.0 Introduction

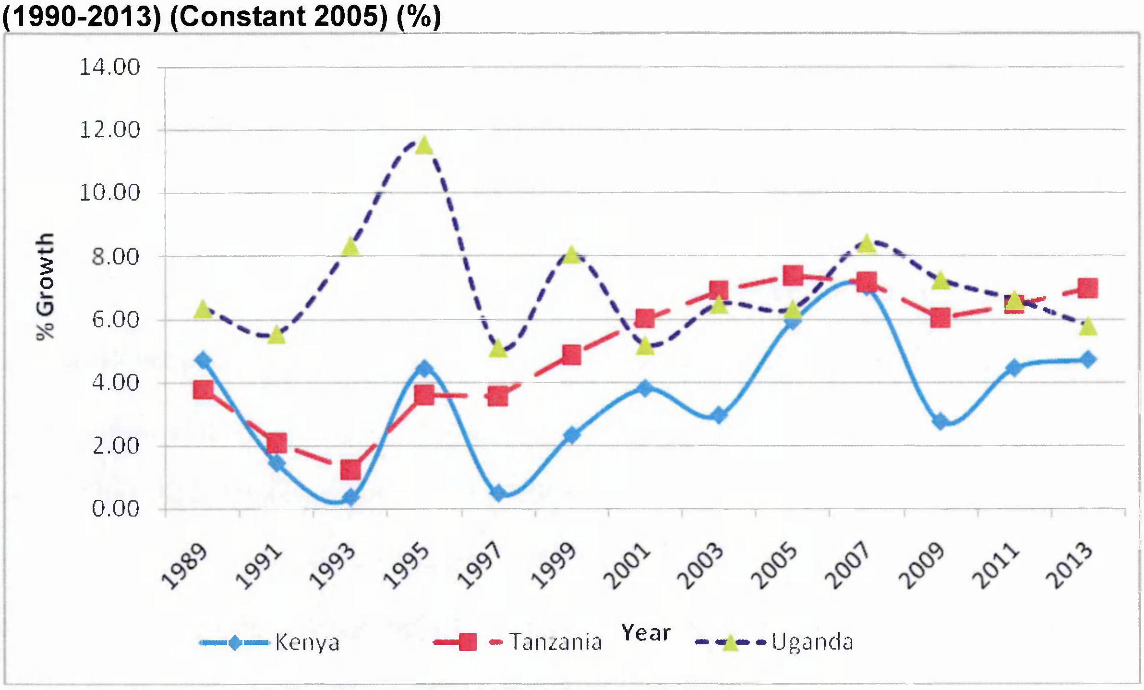
This chapter maps out the state of the Ugandan economy with particular attention to the garment and textile sub-sector. This is then narrowed to the growing presence of the Asian Drivers in the Ugandan economy. This chapter is divided into 12 sections. Section 4.1 focuses on the performance of the economy. This is followed by a discussion on the composition of the Ugandan economy in Section 4.2. Section 4.3 discusses the country's financial sector. This is followed by a description of the country's international trade in Section 4.4. The chapter then continues with a description of the poverty situation in Uganda in Section 4.5. The chapter discusses the labour force in Uganda in Section 4.6. Section 4.7 focuses on the state of Uganda's infrastructure. Section 4.8 describes the Ugandan garment sector. This is followed by a description of the changing market condition in Section 4.9. Section 10 discusses capital equipment imports into Uganda. Section 4.11 discusses how the AD economies fit into the Ugandan garment sector. Section 4.12 concludes the chapter.

4.1 Economic performance of Uganda

In the first decade after independence, Uganda showed good economic performance, with real GDP registering annual average growth rates of over 5 % (Aggrey, 2009). This growth rate was mainly due to the Import-Substitution Industrialisation (ISI) policy that was instituted. This policy contributed largely to a rapid industrialisation of the economy (Aggrey, 2009). This was coupled with a sustained high level of investment, savings and a stable macroeconomic environment. However, as indicated in Chapter 1, the country's unstable political environment in the 1970s and 1980s led to deterioration of the economy (Collier, 1999). Other international issues like the oil crisis in 1973-74, increased protectionism in developing countries, high external interest rates and a decline in concessionary capital inflows in the 1970s and 1980s badly affected the country's economy (Aggrey, 2009 and IMF, 2010).

As a result of the poor performance in the 1980s, the Ugandan government implemented economic reforms to stabilise the economy and restore sustainable growth. Key among the policy reforms included trade liberalisation, foreign exchange liberalisation, and minimisation of government intervention in the economy (Baffoe, 2000 and Aggrey, 2009). Signs of economic restoration started emerging in the early 1990s. This was partly attributed to the fast pace of economic liberalisation during the period. The growth in Uganda's economy was also partly due to the occurrence of good weather which made agriculture the mainstay of the economy (Aggrey, 2009). A diagrammatic representation of this growth – relative to its neighbours, Kenya and Tanzania – is outlined in Figure 4.1—which compares the trends in GDP growth between the three countries.

Figure 4.1: Comparing the trends in GDP growth in Uganda, Kenya and Tanzania (1990-2013) (Constant 2005) (%)



Source: Author's compilation from the World Development Indicators (http://data.worldbank.org/country/uganda; http://data.worldbank.org/country/kenya; http://data.worldbank.org/country/tanzania), accessed 14/03/2014

Figure 4.1 shows very graphically that the GDP growth rate for Uganda was higher than its neighbours for most of the period between 1989 and 2013, except briefly in the early 2000s and post 2012. Uganda's growth rate fell below that of its neighbours in the early 2000s because of the country's worsening terms of trade and bad weather. The bad weather affected agriculture output particularly coffee which was the main export crop and a major foreign exchange earner for the country (Ssewanyana and Bategeka, 2007). It fell again below that of its neighbour's post 2012 because of the energy crisis Uganda experienced in 2011 and 2012 (Mawejje *et al.* 2013).

4.2 Sectoral composition in Uganda's economy

The Ugandan economy is made up of three main sectors—the agricultural, industrial and services sectors (Table 4.1). These sectors determine the economic growth of the economy as outlined in Figure 4.1 above and highlight the relative contribution of each sector to that growth. This section further shows the contribution of each sector to job creation in Uganda (Table 4.2). It also shows the most important sector for garment production – industry – and how this sector has fared over the last two decades relative to its neighbouring countries. This is important to note because it provides contextual background for the rest of the discussions in this thesis. I discuss the details outlined in Table 4.1 for each sector and its contribution to economic growth in more depth below.

Table 4.1: Average sector contribution to GDP by country (1990-2013) (%)

	1990-1994	1995-1999	2000-2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture												
Uganda	52	43	27	27	26	24	23	25	24	23	26	25
Kenya	30	31	30	27	27	25	26	27	25	28	29	-
Tanzania	47	42	33	32	30	30	30	29	28	28	27	27
Industry												
Uganda	13	17	23	25	24	27	27	26	25	25	28	29
Kenya	18	17	17	19	18	19	20	19	19	18	17	-
Tanzania	16	17	21	23	23	23	23	24	25	25	25	25
Services												
Uganda	35	39	50	48	50	50	50	50	50	51	45	46
Kenya	52	51	53	54	55	56	54	54	56	54	52	-
Tanzania	37	42	46	46	47	47	47	47	47	47	47	47

Source: Author's compilation from the World Development Indicators (http://data.worldbank.org/country/uganda; http://data.worldbank.org/country/kenya; http://data.worldbank.org/country/tanzania), accessed 14/03/2014

Table 4.2: Percentage distribution of employment by sector (%)

Subsector	2005/06	2009/10
Agriculture	75	67
Service	20.7	24.5
Industry	4.3	5.5

Source: Author's compilation from the World Development Indicators (http://data.worldbank.org/country/uganda), accessed 14/03/2014

4.2.1 Agricultural sector

The contribution of the agricultural sector to GDP has been declining since 1990. Agriculture contribution to GDP in Uganda declined from an average of 57 % in the early 1990s to 25 % in 2012—the decline is faster than those of Tanzania and Kenya for the same period (Table 4.1). This decline was greatest at the start of the 2000s (from 43% to 27%) – which coincides with the drop in overall economic growth in Uganda as shown in Figure 4.1. The agricultural sector remains around the 25% mark for the rest of the decade. The study does not see a similar drop again around 2012 despite the drop in GDP growth highlighted in Figure 4.1. As indicated by Mawejje *et al.* (2013) above, the decline was mainly due to the energy crisis that the country experienced in 2011 and 2012.

Naluwairo (2011) also explains that the poor performance of the agricultural sector is due to limited public spending in the sector. Despite a decline in the sector's contribution to GDP, it remains Uganda's largest employer (Table 4.2). The sector employed an average of 75 % of the total labour force in 2005/06 (Table 4.2). This figure declined to 67 % by 2009/10 (Table 4.2). Furthermore, 42 % of households in Uganda rely on subsistence agriculture as their most important source of livelihood, while private non-agricultural wage employment has been growing at around 12 % per year—the second highest rate in Africa, only behind Ghana (Uganda MDG Report, 2013). Labour in the sector is less skills intensive, and entry into the sector is easy (FAO, 2012).

Coffee continues to be the main traditional export crop, contributing 18 % of the export earnings between 2000 and 2010, despite the vigorous efforts by government to diversify the economy (FAO, 2012). The crop employs 500,000 small holder farmers (FAO, 2012). Domestic consumption of this commodity in Uganda is relatively small ranging from 4-10 % of production (FAO, 2012). Cotton is also among the key export crop in the country. The cotton crop recorded export revenue of US$41m in 2005. The cotton subsector is dominated by smallholder farmers with average farm sizes of less than 0.5 hectares. The sub-sector employs over 250,000 poor households and serves as a major source of income for rural households (GoU, 2012). The other key export commodities in the country are tea and fish (GoU, 2012).

4.2.2 Service sector

Over the past 15 years, the service sector has been the best performing sector of the economy. Between 2006 and 2010, the sector maintained a 50 % contribution to GDP (Table 4.1 above). The sector's 50% constant contribution to GDP is attributed to the liberalisation of major services sectors including telecommunication, financial services and hospitality (Othieno and Nampewo, 2012). Though the contribution of the services sector to GDP was lower than that of Kenya, it was higher than that of Tanzania (47 %) during the same period (Table 4.1 above). However, the sector's contribution to GDP declined from 51 % in 2011 to 46 % in 2013 (Table 4.1 above). The favourable backward and forward linkage with both the agricultural and industrial sectors of the economy is the main reason for the rise in the services sector (Abdallah and Apaa-Okello, 2009). It has been argued that the rise in the service sector contributed immensely towards the GDP growth rate in Uganda as indicated in Figure 4.1 (Othieno and Nampewo, 2012).

Moreover, the service sector was the second largest employer (24.5 %) of the labour force in 2009/10 (Table 4.2) which correlates with the sector's contribution to GDP growth relative to the other two sectors. Hence, the services sector is complementing the agriculture sector very well in the creation of jobs for the youth, considering that the country's youth unemployment is higher than the continent's average (see Chapter 1 above). However, relative to the agriculture sector however, the services sector is more skills intensive—labour in this sector requires more education and on-the-job experience. This creates a barrier for labour to cross from the agriculture sector into the industrial sector (UNIDO, 2007).

4.2.3 Industrial sector

The industrial sector is the lowest contributor to GDP in Uganda. Between 2000 and 2013, the sector's contribution to GDP was higher than that of Kenya but mixed relative to Tanzania (Table 4.1 above). It is also the lowest contributor to employment creation in the economy (Table 4.2). Obwona *et al.* (2013) attributes this to the absence of manufactured products in the export basket, pointing to Uganda's limited capacity to compete in the competitive global markets. Poor infrastructure, limited access to credit and appropriate capital equipment are among the issues contributing to slow growth in the sector (UNIDO, 2007). Again similar to the services sector, the industrial sector is also skills intensive relative to the agriculture sector. Other economic issues affecting the sector include vulnerability to external price shocks, narrow revenue base and low measured private investment. These issues lead to low productivity in the sector and also have negative implications on poverty reduction since not enough jobs are created in the sector. UNIDO (2007) explains that the inability to achieve increased productivity for the country's growing population is inhibiting the country's poverty reduction goal. This requires a very vibrant manufacturing sector that absorbs locally produced inputs for production (UNIDO, 2007). Nonetheless, the sector increased its contribution to job creation from 4.2 % in 2005/06 to 5.5 in 2009/10 (Table 4.2).

The role of manufacturing in the industrial sector

Manufacturing forms a key part of the industrial sector in Uganda (GoU, 2008). Siggel and Ssemogerere (undated) indicate that the manufacturing sector over the past two decades has contributed significantly to the industrial sector in Uganda. The share of manufacturing to the industrial sector has been constantly above 30 % since 2006 though the rates have constantly fallen below those of Kenya and Tanzania (Table 4.3 below). Employment in formal manufacturing has expanded but remains relatively low. The majority of new jobs have been created in low productivity subsectors, such as retail trade and hospitality (Uganda MDG Report, 2013). The above mentioned challenges are the main reasons why the sub-sector is not competitive when compared to its maritime neighbours. In 2007 the World Bank attributed the absence of truly transformative structural change or large-scale industrialisation in Uganda to inadequate investment in public infrastructure. The Uganda National Housing Survey data shows that the textiles, clothing and footwear sub-sectors contribute 5 % of total employment created in the industrial sector (GoU, 2010). However due to low manufacturing capacity, only 10 % of the cotton produced is processed into garments in the country (GoU, 2009). Lack of the appropriate technology has been identified by the Ugandan Industrial Policy as one of the main issues confronting the sector. The next section describes the industrial policy direction that the country is following to mitigate the issue of technology gap in the sector. In Section 4.10 of this chapter, the study will discuss the sources and value of import of garments making machines into Uganda.

Table 4.3: Share of manufacturing in the industrial sector (%)

	1990-1994	1995-1999	2000-2004	2005	2006	2007	2008	2009	2010	2011
Uganda	46	47	30	28	33	30	30	31	32	32
Kenya	61	71	65	63	67	63	60	58	58	61
Tanzania	50	47	43	39	39	39	39	42	40	40
SSA	48	50	41	35	34	35	34	38	40	41

Source: Author's compilation from the World Development Indicators, http://data.worldbank.org/country/uganda; http://data.worldbank.org/country/kenya; http://data.worldbank.org/country/tanzania, accessed 14/03/2014.

Bridging the technology gap in the industrial sector in Uganda—a policy approach

Ugandan Industrial Policy aims at bridging the technology gap in the manufacturing subsector by *"creating national capacity for Science and Technology, incubation, and innovation, to ensure sustainable industrial transformation"* (GoU, 2008, page 22). In order to achieve this objective, the industrial policy recommends the following policy actions:

> *Strengthen initiatives for industrial and technology development including,..... acquiring appropriate technologies,.....technology transfer and building effective linkages within and outside Uganda with a view to ensuring the continuous acquisition and provision of knowledge resources for industrial development and competitiveness.* (GoU, 2008, page 22)

> *Establish and strengthen, as appropriate, technology centres ....to assist in the identification of technology needs for industry, advise on the selection of technology and ......, analyse information about imported technology and assist in the installation and maintenance of technology.* (GoU 2008, page 22)

> *Conduct technology use and productivity training programs for human resource development at the enterprise level as well as undertake study tours to other countries to learn from them and establish south –south co-operation.* (GoU, 2008, page 22).

According to the document, achieving these policy objectives will improve the growth of the manufacturing sub-sector in Uganda. More importantly it will lead to job creation, increased productivity, savings and surplus. Later in Chapter 9 of this study, I will demonstrate how garment making technologies can be used to achieve these policy objectives. The policy also highlights the importance of an effective cooperation with the financial sector for these policy objectives to be achieved.

4.3 The financial sector

According to the WEO (2012), the financial sector in Uganda is relatively developed, consisting of a range of formal, semiformal and informal institutions. However, access to financial services remains a challenge, particularly in rural areas. Accordingly, formal institutions, including commercial banks, micro-finance deposit-taking institutions, and credit institutions serve only 14 % of the rural population, while informal institutions, such as village savings and loans associations serve approximately another 12 % (WEO, 2012). Furthermore, 62 % of the Ugandan population have no access to financial services and only 4 million people hold bank accounts. This represents 33 % of the 12 million people who are eligible to hold a bank account (WEO, 2012). According to the Uganda National Textiles policy document, it is only 10 % of actors in the garment and textiles sector who transact business with the commercial banks (GoU, 2009). In addition, the sector does not enjoy any form of subsidy or support from the government and cost of borrowing is also very high (see Section 4.3.1 below). The effect is a perennial lack of finance for the sector as opposed to the country's competitor—Ethiopia that enjoys development finance from the Ethiopian government at 7% per annum interest (GoU, 2009).

4.3.1 Lending, interest and inflation in Uganda

The macroeconomic environment remains hostile, exacerbated by the volatile exchange rates, inflation and high interest rates (Mawejje and Nampewo, 2012). The country's lending rate is the highest among its peers—Kenya and Tanzania (Table 4.4). However, inflation and real interest rate performance over the years are mixed relative to its neighbours—Kenya and Tanzania. For instance, the real interest rate for Uganda was the highest (15.91 %) in 2006; yet the economy recorded the lowest real interest rate in 2012 compared to its neighbours (Table 4.4). Uganda's inflation rate continues to be lower than that of Kenya but between 2006 and 2012, the country recorded higher inflation rates compared to those of Tanzania. Fixed fees and high costs of opening and maintaining accounts seem to be the hindering factor in Uganda. For instance, the cost of maintaining a checking account is equivalent to 25% of annual GDP per capita, a good reason to not have an account (Tikri and Faye, 2013, and Akisimire *et al.* 2015). However, Uganda's economic recovery continues to increase investor confidence in the economy. The Ugandan Textile Policy report indicates that low lending, interest and inflation rates are very important for making the garment sector competitive in Uganda.

Table 4.4: Comparing the average lending, interest, and inflation rates in Uganda with Kenya and Tanzania (%)

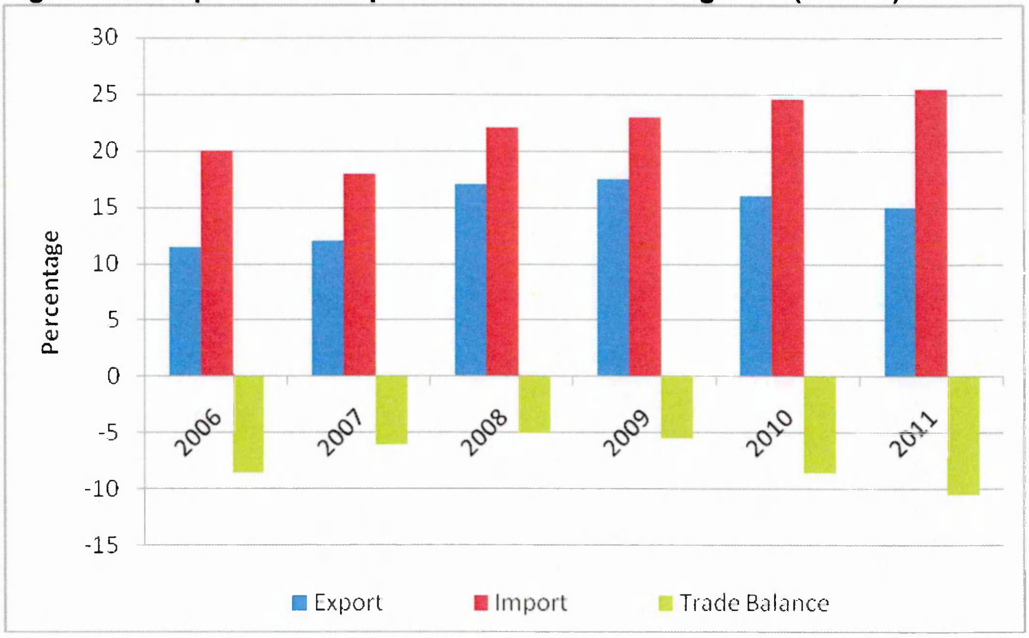
	1996	1998	2000	2002	2004	2006	2008	2010	2012
Real interest rate									
Uganda	15.03	11.10	10.62	23.00	4.34	15.91	13.24	9.70	2.54
Tanzania	12.28	-3.49	13.02	8.68	6.65	9.85	4.42	7.12	3.58
Kenya	-5.78	21.10	15.33	17.36	5.05	5.43	0.71	12.16	8.69
Lending interest rate									
Uganda	20.29	20.86	22.92	19.10	20.60	18.70	20.45	20.17	26.31
Tanzania	42.83	26.27	21.89	20.06	14.52	15.25	16.07	15.03	14.96
Kenya	33.79	29.49	22.34	18.45	12.53	13.64	14.02	14.37	19.72
Inflation, consumer prices									
Uganda	7.19	0.07	3.39	-0.29	3.72	7.31	12.05	3.98	14.02
Tanzania	20.98	12.80	5.92	5.32	4.74	7.25	10.28	6.20	16.00
Kenya	8.86	6.72	9.98	1.96	11.62	14.45	26.24	3.96	9.38

Source: Author's compilation from the World Development Indicators, accessed 14/03/2014; http://data.worldbank.org/country/uganda; http://data.worldbank.org/country/kenya; http://data.worldbank.org/country/tanzania, 01/06/2013

4.4 International trade

Uganda has consistently recorded a negative trade balance over the years this impacts on its competitiveness in garment trade on the international market (GoU, 2009). In 2010 for example, the total ratio of Uganda's exports to GDP was 16 % compared to 24.5 % for import to GDP (Figure 4.2). The gap further widened in 2011 when the economy's exports to GDP recorded 15 % compared to 25.5 % imports to GDP (Figure 4.2). The World Bank (2013) attributes this widening trade deficit to the fact that the economy exports low value added primary commodities such as coffee and cotton, and imports high value added finished products from its trading partners.

Figure 4.2: Exports and imports share of GDP in Uganda (%GDP)

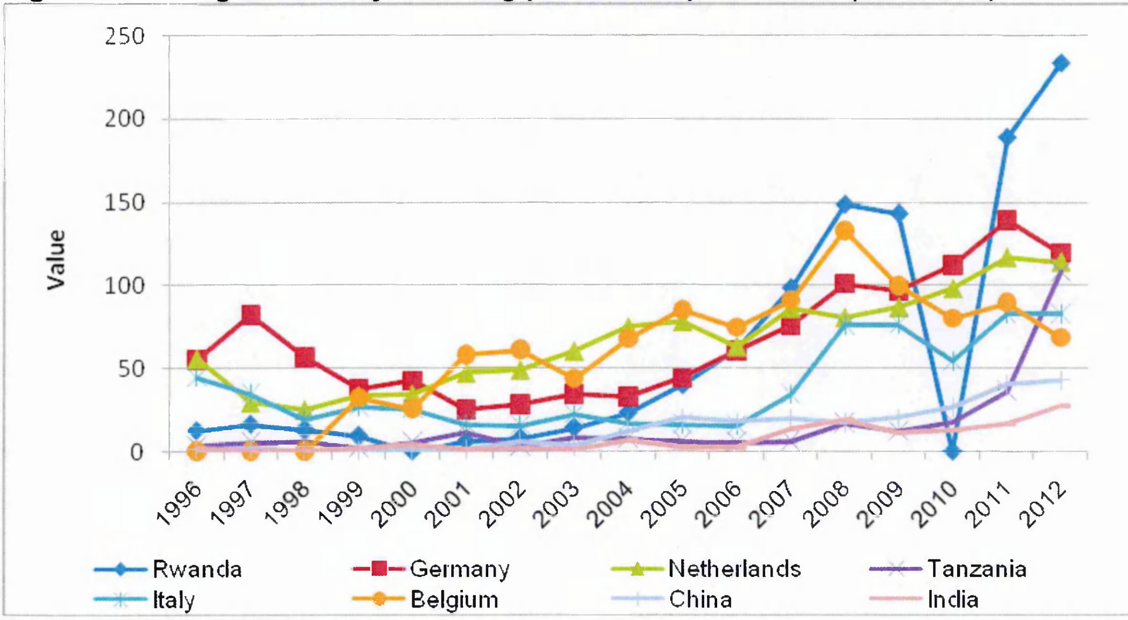


Source: World Development Indicators, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

4.4.1 Direction of trade

As indicated above, Uganda exports mainly to its neighbours—Rwanda and Tanzania. Apart from its neighbours, the country also exports primary commodities to Europe. Germany, Netherlands, Italy and Belgium are the main export destinations in Europe (Figure 4.3). Though Germany continues to remain an important trading partner in terms of exports from Uganda, exports to China have been increasing over the years (Figure 4.3). Uganda exports primary commodities such as coffee, tea, cereals, and tobacco to the European Union and exports manufactured products to its neighbours. The value of exports to the AD economies is far below that of the European Union (Figure 4.3).

Figure 4.3: Uganda's major trading partners-export values (US $ '000)

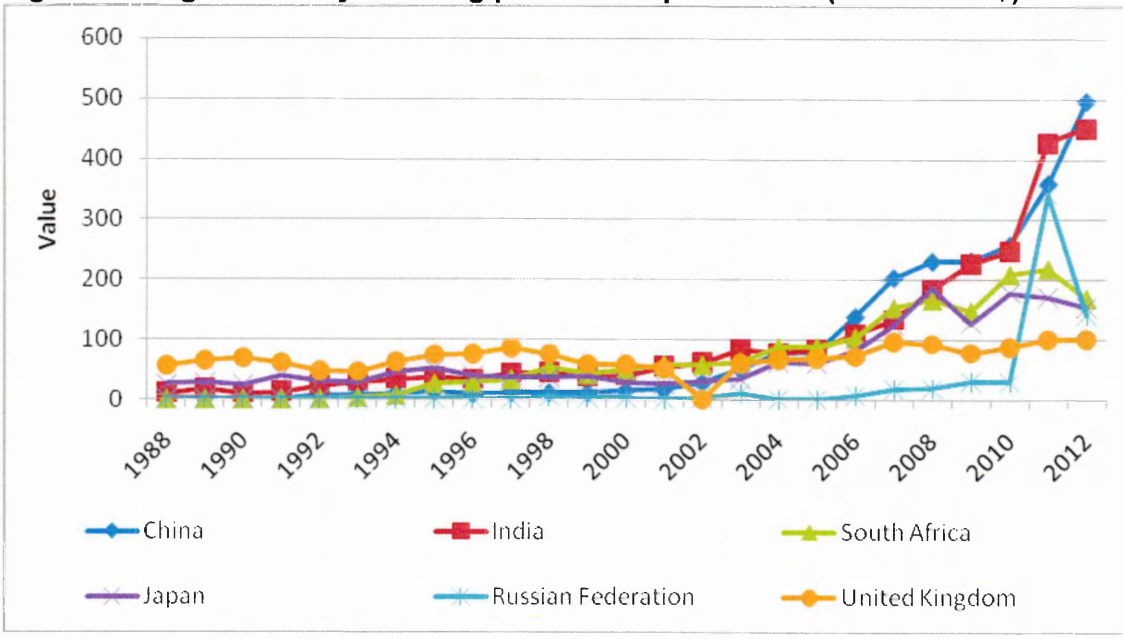


Source: WITS-COMTRADE database, http://wits.worldbank.org/WITS/WITS/AdvanceQuery/RawTradeData/QueryDefinitionSelection.aspx?Page=RawTradeData&querytoken=451684&selection=New, Accessed 15/03/2014

Until 2001, United Kingdom was the most important trading partner to Uganda in terms of imports. But the trend has changed significantly. The AD economies are now Uganda's most important trading partner in terms of imports. Value of imports from the AD economies to Uganda has over the years been increasing steadily (Figure 4.4). For example, Uganda's imports from India increased from US$ 23 million in 1992 to USD 452 million in 2012 (Figure 4.4). Imports from China also increased from US$ 7 million in 1992 to US$ 495 million in 2012 (Figure 4.4). During the same period, the one-time most important trading partner (United Kingdom) only managed to double its exports to Uganda from US$ 56 million to US$ 100 million (Figure 4.4). Among others, Uganda mainly imports pharmaceutical products, textiles and garments, and mechanical appliances from India[3]. Key imports from China include electrical machinery, textiles and garments, and footwear[4]. This data corroborates the argument of this thesis that China and India as AD economies have increasingly become important to the garment industry in Uganda.

[3] WITS database *Access 15/03/2014*
[4] WITS database *Access 15/03/2014*

Figure 4.4: Uganda's major trading partners- import values (Millions US$)



Source: WITS-COMTRADE database, http://wits.worldbank.org/WITS/WITS/AdvanceQuery/RawTradeData/QueryDefinitionSelection.aspx?Page=RawTradeData&querytoken=451684&selection=New, Accessed 15/03/2014

4.5 The poverty situation in Uganda

This section describes the incidence of poverty in Uganda and the progress made so far with the MDG 1 (Target 1.A), which aims at halving the proportion of people whose income is less than one dollar a day by 2015. The section also describes the inequality situation in Uganda. The high rates of poverty and inequality are the underlying issues that have driven the research questions for this thesis and therefore a thorough interrogation of this data is important to set the scene for the whole thesis.

4.5.1 Incidence of poverty in Uganda

Table 4.5 provides more detailed statistics by rural-urban areas. The 2009/10 National Household Survey data shows that the incidence of poverty remained higher in rural areas (27.2 %) compared to urban areas (9.1 %) (Table 4.5). This is coupled with the fact that the majority of the total population in Uganda are rural dwellers and are mainly subsistence farmers (see also Chapter 1 above). Between the last three rounds of the Uganda National Household Survey (i.e. 2002/03, 2005/06, and 2009/10), the total population of Ugandans living below the poverty line has declined from 31.1 % to 24.5 % (Table 4.5). This represents a 14.3 % decline. Uganda has therefore made a significant headway towards the achievement of the MDG 1 due to the decline in poverty in the country.

Table 4.5: Poverty statistics in Uganda (%)

Location	2002/03		2005/06		2009/10	
	Pop. Share	Incidence of poverty	Pop. Share	Incidence of poverty	Pop. Share	Incidence of poverty
Rural	86.2	42.7	84.6	34.2	85	27.2
Urban	13.8	14.4	15.4	13.7	15	9.1
National	100	38.8	100	31.1	100	24.5

Source: Base on the Uganda National Household Survey, 2009/10 (page 75); Base on the Uganda National Household Survey, 2005/06 (page 60) and Base on the Uganda National Household Survey, 2002/03 (page 47)

4.5.2 Progress made with MDG 1: target 1.A halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day

Uganda achieved the target to halve the proportion of people whose income is less than one dollar a day well ahead of the 2015 deadline. This has been driven by an increase in more secure and productive forms of employment and has resulted in a steady reduction in hunger and under-nutrition (Uganda MDG report, 2013). The national poverty head count declined from 56.4% in 1992/93 to 24.5% in 2009/10 (Table 4.6). Due to this progress, the general perception of who is poor has also changed to reflect a demand for opportunities rather than a focus on only absolute deprivation (Uganda MDG report, 2013). If current trends continue, then Uganda will be on course to reach the much more ambitious national target to reduce the poverty rate to 10% by 2017 (Uganda MDG report, 2013). The poverty gap ratio is a measure of the depth of poverty. This is done by determining the extent to which an individual has fallen below the poverty line (Uganda MDG report, 2013). Table 4.6 below shows that Uganda's poverty gap ratio has declined faster than the headcount index. This is true regardless of the geographical location, and is indicative of rising average consumption among Uganda's poor, meaning that individuals below the poverty line are less poor today than in the past.

Table 4.6: Target 1.A halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day

	Status of Progress: Achieved					
Indicator	**1992/93**	**1999/00**	**2002/03**	**2005/06**	**2009/10**	**2015 Target**
Proportion of population below national poverty line (poverty headcount)	54.4	33.8	39	31	24.5	25
Poverty gap ratio	20.3	10	11.9	8.8	6.8	-
Share of poorest quintile in total household consumption	6.9	6.7	6.3	6.4	6.2	-

Source: Uganda MDG report, (2013, page 15)

4.5.3 The state of inequality in Uganda

However, in spite of reduction in poverty levels, the national Gini coefficient in Uganda keeps on rising. The four rounds of the Uganda National Household Survey shows that Uganda's Gini coefficient rose from 0.365 in 1992/93 to 0.428 in 2009/10 (Table 4.7). The Gini coefficient is a measure of statistical dispersion intended to measure inequality among a given population (Hillebrand, 2009). Decomposing by location shows that the rise in inequality is largely driven by the urban areas. This may be partly attributed by the high rate of unemployment in urban areas. This also has negative implications on income distribution in Uganda. The poorest quintile (the bottom 20 % of the income distribution) accounted for only 6.2 % of national consumption and this has remained stable over time (GoU, 2011). In Chapter 6 of this study I will show how AD garment making machines can stimulate the spread of income.

Table 4.7: Uganda's Gini coefficient (%)

Rural/Urban	1992/93	2002/03	2005/06	2009/10
Urban	0.396	0.483	0.432	0.447
Rural	0.328	0.383	0.363	0.375
National	0.365	0.428	0.403	0.428

Source: Base on the Uganda National Housing Survey, 1992/93, (page 52) and Uganda National Housing Survey 2009/10 (page 85)

4.5.4 Average income levels of household heads in Uganda

Table 4.8 illustrates the income distribution patterns by gender and education in Uganda. Income levels for the male household heads are generally higher than their female counterparts. On average, male and female headed households earn an average of US$ 235.89 and US$ 136.53 respectively (Table 4.8). A male household head in an urban setting in 2009/10 was earning a monthly average income of US$ 360.45 and that of his female counterpart was US$ 192.62 (Table 4.8). The difference may be attributed to the difference in skills and training, including literacy between women and men (Pearson, 2000). As explained by Pearson (2000), most women in developing countries like Uganda are uneducated and illiterate; and this makes them go for unskilled and lower paid jobs compared to men. Income levels in rural communities were generally lower than those in urban communities for both males and females (Table 4.8). Similarly, average monthly income increased with increased education attainment in both urban and rural communities (Table 4.8). Later in Chapter 6 of this study, I will show how these income differences affect the distribution and choice of garment making machines.

Table 4.8: Ave. monthly income of household head by sex and education (US $)

	2005/06			2009/10		
	Urban	**Rural**	**Ave**	**Urban**	**Rural**	**Ave**
Sex						
Male Headed	179.2	20.53	99.87	360.45	111.32	235.89
Female Headed	116.57	43.63	80.10	192.92	80.13	136.53
Educational Level						
No Formal Education	77.21	25.72	51.47	121.24	69.44	95.34
Some Primary Education	90.09	51.54	70.82	109.99	77.43	93.71
Completed Primary 7	119.52	13.87	66.70	206.42	118.53	162.48
Some Secondary Education	153.1	50.51	101.81	212.44	120	166.22
Secondary/Post-Secondary Education	213.27	22.93	118.10	619.64	285.92	452.78

Source: World Development Indicators, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

4.6 A description of the labour force in Uganda

The total labour force as at 2009 was 14.08 million in Uganda. The employment to population ratio was 81.8 % in 2009 (Table 4.9). As indicated above in Section 4.2, more than 50 % were in the agriculture sector with the remaining employees spread between the services and industrial sector of the economy. Experts in the garment industry in Uganda indicate that the garment industry – as is outlined below – makes up 5 % of the workforce and has a gender bias (field interviews, 2012).

4.6.1 Labour force by gender

Since 1999, the employment rate for males in Uganda has been consistently higher than that of females (Table 4.9). The percentage of males out of the total labour force ranged between 52.92 % (47.08 % for female) in 1999 and 53.31 % (46.69 % for female) in 2009 (Table 4.9). Again, males constituted 88.8 % of the total labour force aged 15 years and above in 1999 (76.1 % for female) and 88.3 % (75.3 % for female) in 2009 (Table 4.9). This supports the observation made in the Uganda National Housing Survey report for 2005/06 that males are able to earn higher income than their female counterparts mainly because it is easier for them to get jobs. In Chapter 6 of this study I will demonstrate that as a result of low income levels, female garment producers prefer to acquire less capital intensive garment making machines.

Table 4.9: Uganda's labour force and employment to population ratio

				Employment to Population Ratio for ages 15+ (%)		
Year	**Total labour force (millions)**	**Female %**	**Male %**	**15+, Female (%)**	**15+, Male (%)**	**15+, Average (%)**
1999	10.24	47.08	52.92	76.1	88.8	82.4
2000	10.55	47.50	53.00	75.9	88.8	82.3
2001	10.87	46.97	53.03	75.8	88.7	82.2
2002	11.22	46.88	53.12	75.8	88.8	82.2
2003	11.57	46.86	53.14	75.7	88.7	82.1
2004	11.95	46.83	53.17	75.6	88.6	82.1
2005	12.34	46.81	53.19	75.6	88.6	82.1
2006	12.74	46.79	53.21	75.5	88.6	82.1
2007	13.17	46.77	53.23	75.4	88.4	81.9
2008	13.61	46.76	53.24	75.4	88.3	81.8
2009	14.08	46.69	53.31	75.3	88.3	81.8

Source: Author's compilation from World Development Indicators, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

4.6.2 Labour force by education

Table 4.10 below shows the percentage distribution of the working population by their level of education and location. The two rounds of the Uganda National Housing Survey both show that more than 70 % of the working population in Uganda have primary education or below. The first round of the Uganda National Housing Survey in 2005/06 shows that the working population with specialised skills constituted 5 % (Table 4.10). The number increased to 7 % in the second round of the housing survey in 2009/10 (Table 4.10). Furthermore, the employment rate in urban communities is relatively lower than that of rural communities. In urban areas, the rate of employment increased from 12 % in 2005/06 to 15 % in 2009/10 (Table 4.10). The rates were higher in rural communities but 85 % of the labour force is in the agricultural sector (Table 4.10). This is coupled with the fact that more than 40 % of the total labour force in rural communities was underemployed in 2009/09 (GoU, 2010). As a result, the Uganda Household Survey reports (2009/10) recommend the need to invest in the manufacturing sector so as to absorb the excess labour from the agriculture sector. I will demonstrate in Chapter 9 how garment making technologies in the Ugandan garment sector can be used to absorb the excess labour in the agriculture sector in both the urban but especially the rural areas of the country.

Table 4.10: Distribution of working population by education level and location (%)

	2005/06	**2009/10**
Level of Education		
Primary school and below	76	74
Secondary	18	18
Specialised Training	5	7
Others	1	1
Total	**100**	**100**
Location		
Rural	88	85
Urban	12	15
Total	**100**	**100**

Source: Author's compilation from the Uganda National Housing Survey 2009/10 (page 32-34)

4.6.3 The employment problem in Uganda

As indicated in Sections 4.2.1, 4.2.2, and 4.2.3 above, both the services and industrial sectors are skills intensive, relative to the agriculture sector in Uganda. Thus, it is perhaps unsurprising due to the low level of education and training – as outlined in Table 4.10 above – to see that most of the labour force concentrated in the agriculture sector where minimum skills may be required (Section 4.2.1 above). In Section 2.1.1

above, I have outlined the importance of considering capabilities and knowledge of individuals – the soft technologies – as well as the physical equipment requirements of the garment industry—the hard technologies. It is for this reason that it is important to understand the skills gap and its impact on employment levels in Uganda for this study. As outlined in Chapter 2, skills form an important component of soft technology and it is acquired through training and capacity development of labour.

Largely, studies show that most technologies are developed to be masculine inclined, mainly because of male dominance in engineering (Håpnes and Rasmussen, 1991). As indicated by Gill *et al.* (2010), women are relatively less skilled with higher levels of illiteracy compared to men. This creates more barriers for women when it comes to access and use of technologies in general. Furthermore, women in developing countries bear a disproportionate burden undertaking time and labour intensive unpaid activities such as cooking, and fetching fuel or water in their household (Gill *et al.* 2010). This makes it difficult for women to venture into skills development activities. Consequently they find it difficult to adopt skills intensive technologies (Gill *et al.* 2010).

Skills create a barrier for employment (particularly in the industrial and services sectors) for a large proportion of the labour force in Uganda (GoU, 2012). Furthermore, the country's youth population growth is one of the fastest in the world and highest in Africa (Uganda MDG report, 2013). The number of entrants into the labour force is increasing rapidly, and with over half of the population under the age of 15 this is set to accelerate (Uganda MDG report, 2013). The youthful population will have a long-lasting effect on Uganda's development trajectory (Uganda MDG report, 2013).

The National Development Plan of Uganda, 2010/11–2014/15 shows that the youth are better educated than in the past and remains in school for longer, but are often unable to fully utilise higher levels of human capital (GoU, 2010). 5 % of the labour force has higher educational attainment than required for their current jobs in Uganda (Uganda MDG report, 2013). The proportion of youth able to find wage employment has increased but remains lowest for the most recent labour market entrants, with up to three quarters self-employed or by their families (Uganda MDG report, 2013). Unemployment has increased, but still remains rare and usually confined to the relatively well-off who can afford to wait for a better opportunity. Under-employment is of much greater concern with women and those engaged in agriculture particularly likely to work fewer hours (Uganda MDG report, 2013).

While there may be between 600,000 and 700,000 new entrants into the labour market each year, net job creation is a fraction of this (10 %) (Uganda MDG report, 2013). 65 % of them are unskilled (Uganda MDG report, 2013). However, the vast majority of new jobs created (particularly outside the agriculture sector) require highly skilled labour. Furthermore, new enterprises tend to be small (with only 1.6 workers on average), and have poor survival prospects (Uganda MDG report, 2013). More than a quarter of jobs may be lost each year due to business failure, and with the entry of small and microenterprises likely reaching a limit, recent employment growth may prove unsustainable. The imbalance between labour supply and demand is only likely to grow if the binding constraints to the entry and expansion of professional business ventures are removed, particularly the shortfall of appropriate technical and managerial skills (Uganda MDG report, 2013). This is one of the reasons why the Industrial Policy of Uganda recommends the use of labour intensive technologies as a means of creating jobs in Uganda (GoU, 2008). The document recognises this as the panacea for job creation in the country.

4.7 The state of infrastructure in Uganda

Adequate infrastructure is important for economic growth and competitiveness in Uganda (Ranganathan and Foster, 2012). Uganda generally has poor infrastructure and this makes highly infrastructure dependent technologies expensive to operate. The resultant effect is low productivity in the sector. The study focuses the infrastructure discussion on energy and transport infrastructure considering that they have been identified as influencing the level of profitability of garment production in Uganda (GoU, 2009).

4.7.1 Energy infrastructure in Uganda

Uganda's energy cost is the highest in the East African Community, accounting for 15-20 % of total production costs in 2008 (GoU, 2012). The main source of energy for Uganda's industry is hydroelectricity. More than 70 % of the total electricity was generated through hydroelectricity in 2011. Other sources of energy generation are from thermal and bagasse (Table 4.11). There are four different categories of consumers—small general, industrial (large scale) and general (medium industrial) consumers. In the context of this study, the small and large scale garment producers are respectively classified as small general and industrial energy consumers.

According to the World Development Indictor database, general access to electricity is a huge challenge. Specifically, the database shows that only 9 % of the total population of Uganda had access to electricity by 2009. This figure declined to 8.5 % in 2010. Moreover, those who are able to access power experience frequent power cuts in the country. This hobbles business activities and competitiveness, and consequently hinders output growth in the country (Ranganathan and Foster, 2012). The World Bank's enterprise survey that was undertaken in the mid-2000s found that around 45 % of firms cited high cost of power as a major constraint to doing business in the country (World Bank, 2006). Firms that were interviewed during the survey reported over 130 outages a year. The survey further indicates that annual cost of power in Uganda increases by 75 %. They also spend an average of 55 days without power annually (World Bank, 2006).

The frequent power surges also lead to loss of some advanced equipment and machines not working efficiently in Uganda. This imposes a strong constraint on the growth of the economy particularly the manufacturing sector (UIA, 2013). Again, the country's low capacity in energy generation continues to affect the investment climate. In view of that Uganda is making a lot of efforts to encourage public-private partnership to develop the energy sector. For instance, in 2011, the highest amount of investments was recorded in the electricity and gas sector, accounting for US$ 445 million. This also led to the creation of 75,547 jobs (UIA, 2013). Later in Chapters 5 to 9 of this study, I will discuss the importance of energy to garment-making technologies in Uganda.

4.7.2 Transport infrastructure in Uganda

Uganda is served by road, rail and air transport. The road is by far the dominant mode of transport considering that Uganda is a landlocked country. The challenge is that only 16 % of the total road network is paved. The Uganda National Housing Survey 2009/10 shows that most of the unpaved roads are concentrated in the rural communities (GoU, 2010). Average transport cost constituted 15 % of total production cost in 2008 (NTMP 2009). This generally increases the cost of production. Therefore as indicated by Milner *et al.* (2013), Morrissey and Rudaheranwa (2012) and Rudaheranwa (2009), in chapter 2, transport cost cannot be ignored in the production of goods and services in Uganda. Furthermore, it is more expensive for the same technology to be transported to rural areas. In Chapters 6 and 7, the study will discuss the cost of transport as well as the challenges involved in accessing garment-making technologies in Uganda. Table 4.11 provides data on the national roads network in the country. The country increased the length of paved roads from 2,848 kilometres in 2007 to 3,264 kilometres in 2011, an increase of 416 kilometres of paved roads (Table 4.11).

Table 4.11: Summary of the road networks in Uganda (Kilometres)

Category of Roads	2007	2008	2009	2010	2011
Annual Progress (Paved)	132	120	21	123	152
Total Paved	2,848	2,968	2,989	3,112	3,264
Total Unpaved	7,652	7,532	17,011	16,888	16,736
Total National Network	10,500	10,500	20,000	20,000	20,000
% Paved	27.12	28.27	14.95	15.56	16.32

Source: World Development Indicators, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

Air transport is another important means of transport in Uganda. Compared to its neighbours—Kenya and Tanzania, Uganda has the lowest air and rail infrastructure (GoU, 2012). Accordingly, Uganda is only able to transport small quantities of goods and passengers by air compared to its neighbours Kenya and Tanzania. For instance in 2008, Uganda carried an average of 63,160 passengers through its airport (Table 4.12). This figure was far lower than that of Kenya (an average of 2.6 million passengers) during the same period (Table 4.12). This is partly due to the inadequate investment in air transport in the country. It is also one of the reasons why the country's industrial competitiveness has over the years been on the lower side relative to its neighbours—Kenya and Tanzania.

Table 4.12: Comparing transport infrastructure in Uganda and its maritime neighbours

	2002	2004	2008
Kenya			
Total Railway network(Km)	2,634	2,634	1,917
Air Transport Freight (mill ton-Km)	118.38	193.46	301.22
Air Transport(passenger carried)	1,599,843	2,005,473	2,685,148
Tanzania			
Total Railway network(Km)	4,582	4,582	2,600
Air Transport Freight (mill ton-km)	2.32	2.25	1.69
Air Transport(passenger carried)	174,559	243,087	189,844
Uganda			
Total Railway network(Km)	259	259	259
Air Transport Freight (mill ton-km)	21.00	26.68	34.00
Air Transport(passenger carried)	40,560	45,711	63,160

Source: World Development Indicators, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

4.8 The garments and textiles sector in Uganda

This section discusses the garments and textiles supply chain in Uganda and identify the sector's contribution to GDP, job creation as well as the challenges confronting the sector. The section also captures the sources and values of garment imports into Uganda.

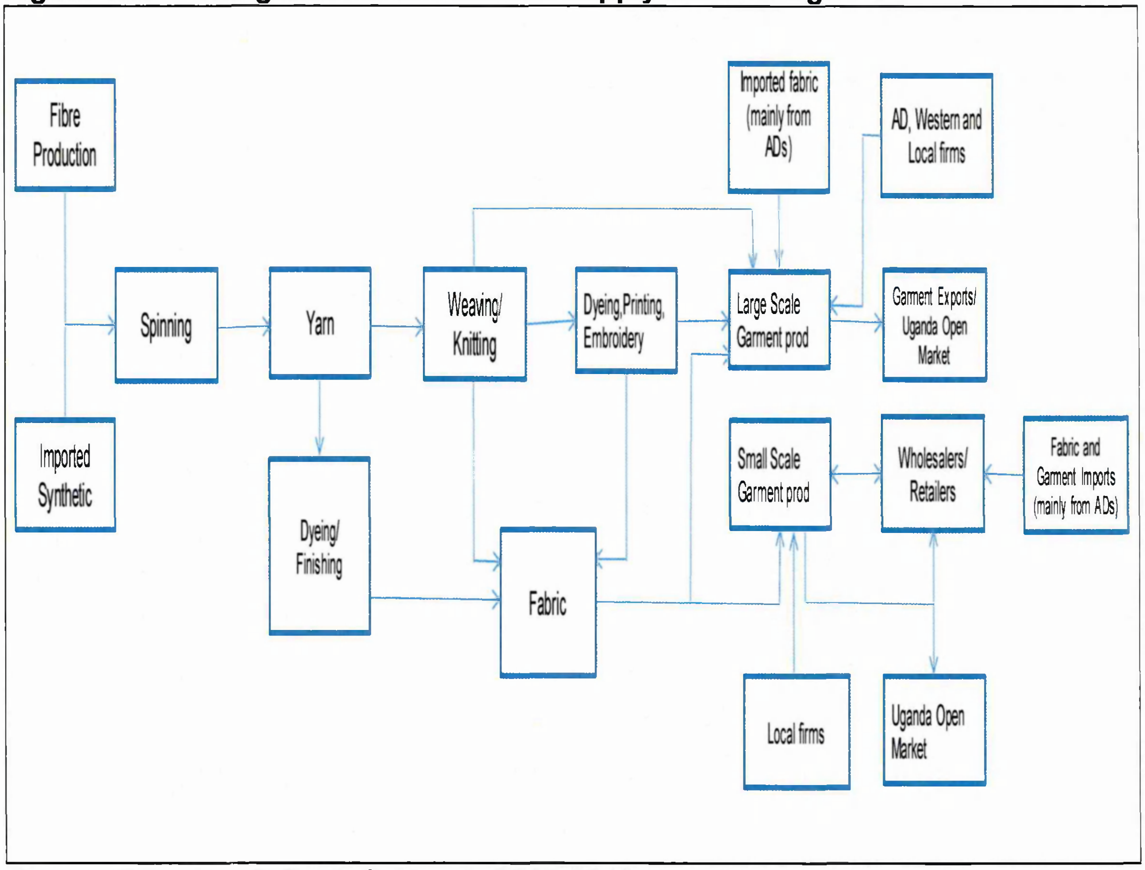
4.8.1 The garments and textiles supply chain

The garment and textile value chain starts from textiles production and ends with the final consumer of garments in Uganda. Figure 4.5 graphically illustrates the garments and textiles value chain in Uganda. I begin with a discussion on first the textiles section of the value chain and then move on to discuss the garment component.

The textile production stage of the G&T supply chain

Figure 4.5 below describes the garment and textiles supply chain in Uganda. The first step in textile products processing is spinning (Figure 4.5). It is the process of making yarn from the cotton lint (Amsalem, 1983). It involves twisting of fibres to form yarn—this involves the process of drawing out, inserting the twist, and winding of the yarn onto bobbins (Amsalem, 1983). There are currently two functional textiles mills in Uganda—Phenix Logistics and Southern Range Nyanza (NYTIL)—out of five textile mills that were functional in the 1960s and 1970s. NYTIL is located in Jinja and that of Phenix Logistics is located in Kampala, both are in the central region of the country. These firms are located in the central region of Uganda mainly because of the presence of skilled labour and infrastructure such as energy, roads, water, etc. (GoU, 2009). Each spinning unit employs an average of 15 machine operators and it is one of the most skills intensive stages of the supply chain. The skills intensive nature of spinning operations serves as a barrier for labour to operate at this stage of the chain.

Figure 4.5: The garments and textiles supply chain in Uganda



Source: Based on Author's fieldwork, 2012-2013

I observe that most of the common spinning machines in Uganda are ring and rotor spinning machines (based on field interviews, 2012). The two spinning mills and their parts mainly originate from Germany and Austria (based on field interviews, 2012). There are no AD originated spinning machines in Uganda (Base on field interviews, 2012). The cost of textile spinning in Uganda is very high—mainly because of high energy and maintenance cost of the machines (GoU, 2009). As these machines are obsolete and not in production anymore this makes spares difficult to access. This is coupled with a high rate of taxation, high utility costs, and high labour costs (GoU, 2009) as partly outlined in Section 4.7 above. The resultant effect according to my field interviewees (2012) is that the spinning machines are only able to operate at 30 % of their full capacity. Apart from the two spinning mills in the country, there is also the presence of a few wooden made hand looms. The present combined annual production for the two functional mills plus the production made by the informal sector is still averaged at a paltry 25 million meters capacity as compared to 70 million metres for neighbouring Ethiopia (GoU, 2009).

The cost of cotton on the local market is relatively more expensive hence the two textile firms only procure 10 % of the total volume of cotton produced locally (GoU, 2009). The high cost of the locally produced cotton makes the textile firms substitute cheap imported synthetic lint for the locally produced cotton as the main inputs for the spinning (Figure 4.5). The imported synthetic lint is 300 % cheaper than the locally produced cotton lint (GoU, 2009). Besides, they are mainly imported from the AD economies. The long run effect is a low demand for the locally produced cotton on the local market. The spinning process leads to yarn production (Figure 4.5 above). The yarn can be woven or knitted into fabric. The fabric is the product from the spinning process and this serves as the input for garment manufacturing (Figure 4.5 above).

4.8.2 The garment component of the supply chain

The manufacture of garments in Uganda is mainly dominated by small to medium scale producers who largely produce for the local and regional markets. 80 % of them are involved in the production of traditional attires like “Kanzu”, “Gomazes” and shirts made out of “kitenge”. “Kanzu” and “Gomaze” are special traditional attires that are mainly used during marriage ceremonies. A “kitenge shirt” is a traditional simple garment with various colours and designs printed on them. It is usually unisex and can be worn for a variety of traditional programmes. Later in Chapters 7, 8 and 9, I will use the “kitenge shirt” as a measure of output in my analysis on profitability of the garment making machines from the AD economies and Western economies. Production of garments is at the small and large scale levels in Uganda.

Small scale garment production

The small scale producers produce mainly for the local market. The small scale producers support the livelihood of 2.5 million people across the garment and textiles supply chain (GoU, 2013). They rely mostly on imported fabrics from the AD economies for the production of garments. The fabrics are imported and marketed by wholesalers and retailers (Figure 4.5 above). The small scale garment producers either sell the garment through the wholesalers and retailers or sell them directly in the open market (Figure 4.5 above). Unlike textile production, there are both AD and Western garment making machines at this level (see detailed discussion in Chapter 5).

Large scale production

Unlike the small scale producers, the large scale producers produce for both the local and international markets (Figure 4.5 above). According to the Uganda Investment Authority, the AD owned large scale firms constitute more than 50 % of large scale garment production firms in Uganda (UIA, 2013) (see also Chapter 6). These firms have some sense of how international markets are organised and how to go about finding contract opportunities. They mainly export garment to countries like Rwanda, Democratic Republic of Congo, and other countries in the Great Lake regions (UIA, 2013). However, garments and textiles exports into the international market have continuously been impeded by the high cost of doing business in terms of transportation, energy and finance which leads to low competitiveness of garment exports from Uganda.

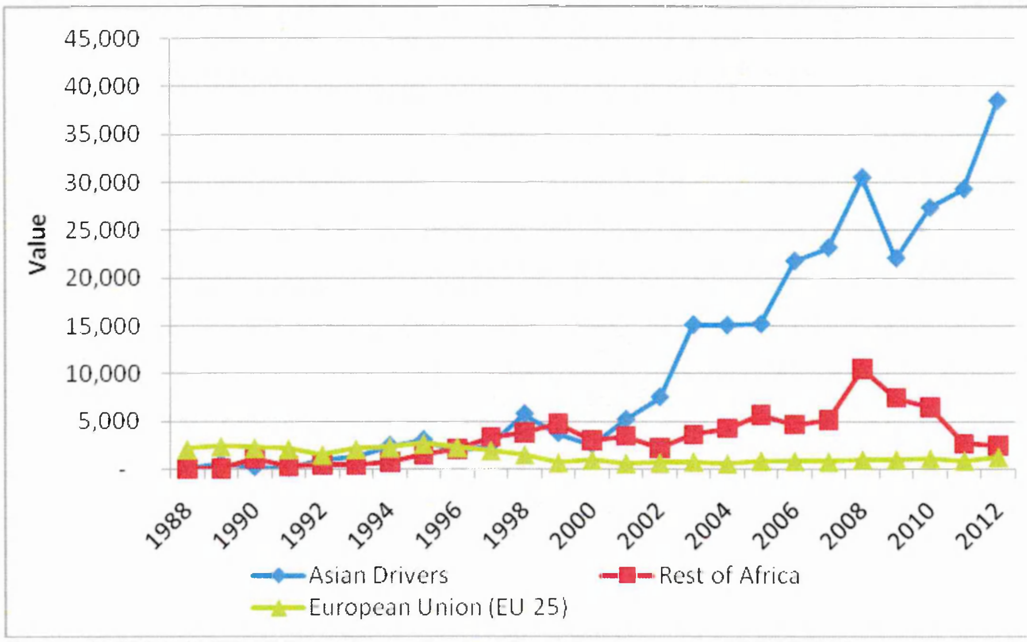
Similar to the small scale producers, 90 % of the fabrics used for garment production are imported (UIA, 2013). The large scale firms import them on their own instead of procuring them from the local wholesalers or retailers (Figure 4.5 above). Furthermore, there are both AD and Western made garment making machines at this level of the supply chain. However as specified above, there are no AD originating textiles making machines to sample for the study. Therefore, the study focuses on only garment production in subsequent chapters since there is a nationwide spread of both AD and Western originating garment making machines in the country. Chapter 5 presents a detailed discussion on the various garment making machines at each stage of the production process.

4.8.3 Sources of apparel imports into Uganda

Figure 4.6 below shows the sources and value of garments and related products imported into Uganda. Europe (i.e. EU 25[5]) was the main source of imports of garments and related products into Uganda e.g. in the form of second-hand clothes. However since 2001, the value of garment and its related products imports from the AD economies—China and India— has far surpassed that from the European Union. The value of garment imports from the AD economies increased from less than US$ 1 million in 1998 to US$ 38 million in 2012 (Figure 4.6). However, imports from the European Union declined from US$ 2 million in 1998 to US$ 1.1 million in 2012 (Figure 4.6). Uganda also imports finished garment products from other African countries such as Kenya, South Africa and Tanzania. Import of already made garments has been recognised as the main challenge confronting garment production in the country (Othieno and Shinyekwa, 2011). Local producers are finding it very challenging to compete with the cheap garment imports from the AD economies. However, there is an ever-increasing demand for cheap garments from the AD economies mainly because of the low income levels of consumers (GoU, 2009).

[5] EU 25 denotes 25 member countries in the European Union.

Figure 4.6: Imports of apparel/clothing/accessories into Uganda (000 US$)

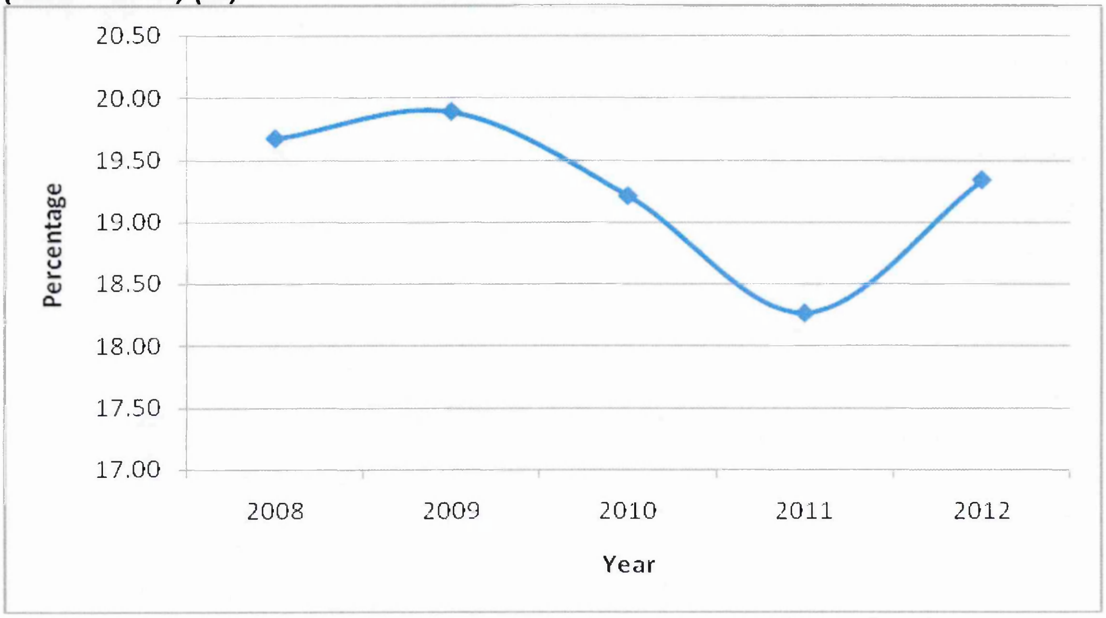


Source: WITS-COMTRADE database, Product Code 84, Accessed 15/03/2014

4.8.4 Challenges and contribution of the garment sector to total manufacturing in Uganda

Figure 4.7 below shows the trends in the garment sub-sector's contribution to total output in the manufacturing sector. The sector's share of total manufacturing was 19.67 % in 2008 (Figure 4.7). This declined to 18.26 % in 2011 but the sector's share increased to 19.34 % in 2012 (Figure 4.7). Garments are among the top 10 household expenditure items and are a source of livelihood for 600,000 Ugandans (field interviews, 2012). As indicated earlier in Chapter 1 above, issues such as lack of technology, poor infrastructure, and limited access to credit are among the factors contributing to the stagnation in the development of the sector. In addition, worker productivity in the garment and textile Sector in Uganda is low. This is due to a combination of factors such as low levels of basic skills, poor or non-existent training, ineffective wage incentives, lack of bundling production flow-through, and use of outdated equipment that does not allow for higher through-put (USAID, 2003).

Figure 4.7: Garment sector's share of total output in the manufacturing sector (2008 – 2012) (%)

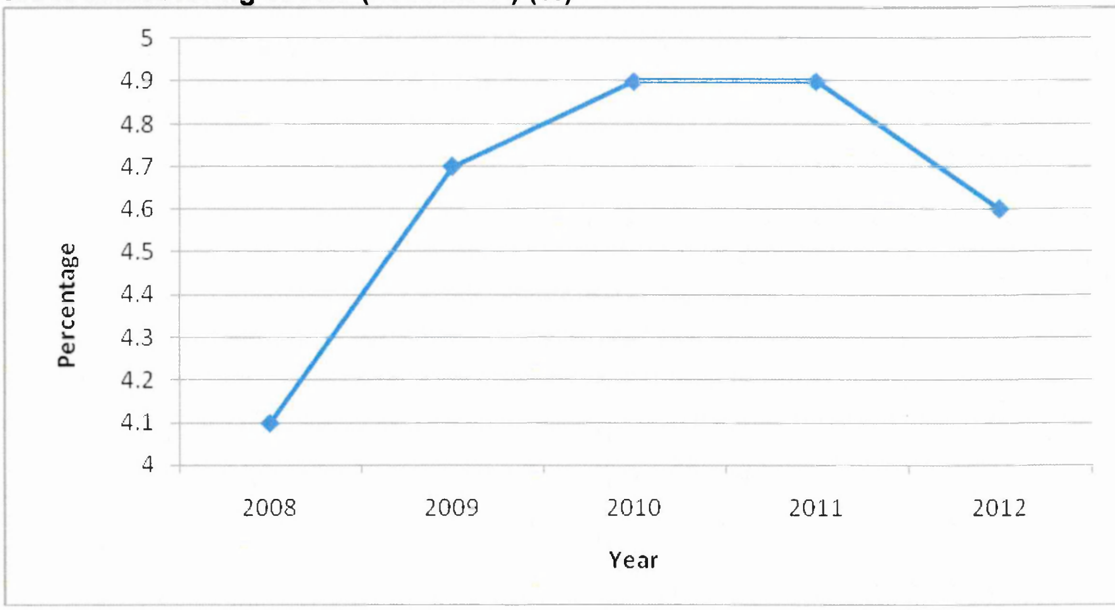


Source: Authors compilation from the Uganda Bureau of Statistics, Statistical Abstract, (2013) page 148

4.8.5 Jobs in the Ugandan garment sector

As indicated above, though the sub sector is considered to be underperforming relative to its full potential, it serves as a source of livelihood for millions of people. Figure 4.8 below shows the trends in the garment sector's contribution to employment in the Ugandan economy. The sector's average contribution to employment in the manufacturing sector was 4.1 % in 2008 (Figure 4.8). This increased to 4.9 % in 2009 and remained the same in 2010 but declined to 4.6 % in 2012 (Figure 4.8). Women and the youth are the most employed across the supply chain (GoU, 2009). 56 % of the total labour force in the garment sector is women (GoU, 2009). With added capacity at spinning, weaving and finishing stages, more jobs can be created beyond the present 2.5 million across the supply chain (GoU, 2009).

Figure 4.8: Trend in the garment sub-sector's contribution to job creation in the manufacturing sector (2008-2012) (%)



Source: Source: Authors own compilation from the World Development Indicators database, http://data.worldbank.org/country/Uganda, Accessed 14/03/2014

Table 4.13 below shows the share of monthly household expenditure on garment by location. On average, consumers spent 7 % of their income in 2009/10 on garments. This declined to 5 % in 2010/11. Rural households spent an average of 6 % of their income on garments in both 2009/10 and 2010/11 (Table 4.13). This was lower than the urban household expenditure in 2009/10 but higher in 2010/11(Table 4.13). Households mostly spent money on cheap garments from the AD economies or imported second hand clothes from the United Kingdom (GoU, 2009). The National Textile Policy of Uganda observes that Chinese made garment are available in every part of the country relative to the locally produced ones (GoU, 2009). The huge presence of AD originating garments particularly those from China were as a result of the expiration of the Agreement on Textiles and Clothing (ATC) on 1 January 2005.

Table 4.13: Share* of monthly household expenditure on garments by location (2005/06-2010/11) (%)

Location	2005/06	2009/10	2010/11
Urban	8	8	4
Rural	8	6	6
Uganda	8	7	5

Source: Author's compilation from the Uganda Bureau of Statistics' Statistical abstract, (2013). Page 27,
**This computation does not does not take into account food, drink and tobacco*

4.9 Effect of changing market conditions on Uganda: the role of the AD economies

From 1974, the Multifibres Agreement (MFA) oversaw the international textiles and garments trade. A large portion of textiles and garment exports from developing countries were based on bilaterally negotiated quotas (OECD/WTO/IDE-JETRO, 2013). The MFA was replaced by the World Trade Organisation (WTO) Agreement on Textiles and Clothing (ATC) in 1995, which scheduled a 10-year transitional process for removal of these quotas (OECD/WTO/IDE-JETRO, 2013). The MFA/ATC restricted exports to the United States and the European Union (EU) by imposing country quotas on the volume of certain imported products (Gereffi and Frederick, 2010). This was designed to protect the domestic industries of these high income markets by restricting imports from highly competitive suppliers such as China (Thoburn, 2009). Notable among the restrictions were tariff increases, tariff peaks, export competition measures and non-tariff barriers (Gereffi and Frederick, 2010 and OECD/WTO/IDE-JETRO, 2013).

The ATC expired in January 1, 2005. Africa, not least Uganda, was also enjoying duty and quota free access and lower import duties to both the United States of America and Europe through the African Growth and Opportunities Act (AGOA) and the Economic Partnership Agreement (EPA) respectively (Fukunishi, 2009 and Thoburn, 2009). The AGOA facility offers preferential market access for clothing and some textiles upon which Sub-Saharan countries such as Uganda can rebuild their industries. There was the fear that transnational corporations will take advantage of the open market and deregulated labour forces after the end of these trade agreements (Pearson, 2003). However, this was not entirely the case in the garment sector. Rather, the expiration of the MFA/ATC led to an increase in export volumes of AD garments to United States of America and the European Union. The growing presence of AD based exporters within this sector crowded out African garment exporters on the American and European markets (Gereffi and Frederick, 2010). One important issue that affected Uganda's competitiveness on the international market is the inability of Uganda to have internationally acceptable fabric quality that can be used to produce exportable garments (GoU, 2009). Though the AD economies have outcompeted Uganda on the international market, they are increasingly becoming the major sources of import for capital equipment.

As I indicated in Chapters 1 and 2 above, the AD economies are becoming the sources of hard and soft technology for developing countries like Uganda. Though this study does not consider the Ugandan Asians in this study, I acknowledge the fact that they also play a very important role in the transfer of technologies to developing countries. The Ugandan Asians are the Asians who have gained permanent residency in Uganda. In contrast, the Asian Driver migrants I consider in this study are mainly nationals from China and India who have only just arrived in Uganda as the Asian Driver economies started to look outwards and their recent impact on African economies was realised.

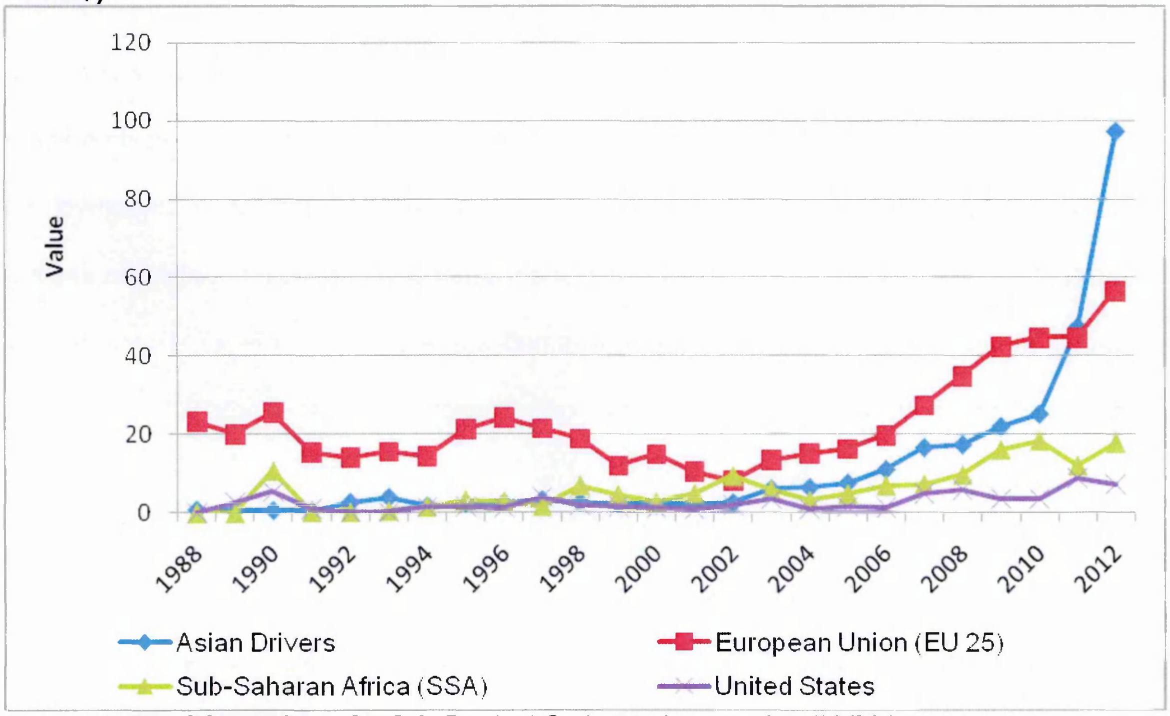
4.10 Imports of capital equipment into Uganda

Capital equipment is an important area of concern which needs upgrading to enhance the overall competitiveness of the garment and textile sector. Uganda imports industrial and small scale garment making machines from the AD and Western economies. Countries such as South Africa and Kenya are also major sources of import. Following the World Integrated Trade Solution (WITS) classification standards, I classified the garment-making machines into small scale and industrial types. The small scale sewing machines are mainly used at the informal small scale production level. The industrial sewing machine on the other hand focuses on commercial garment production.

4.10.1 Import of industrial machines into Uganda

Figure 4.9 presents the sources of imports of industrial machines into Uganda. Until 2010, the European Union (EU) was the main source of import of industrial machines into Uganda. However, there has been a steady rise in the importation of industrial machines from the AD economies (i.e. China and India) into Uganda. The value of industrial machine importation from the AD economies into Uganda rose from US$ 2 million in 1998 to US$ 98 million in 2012 (Figure 4.9). Since 2004, the value of imports of industrial machines from the USA has remained lower than those from the AD economies (Figure 4.9). Figure 4.9 further shows that the value of industrial machine imports from the AD economies into Uganda has surpassed those that are imported from other sub-Saharan African countries (SSA). This was partly due to the liberalisation of the economy—which allowed duty free importation of industrial machines (Shinyekwa and Mawejje, 2013). Imports of industrial machines from the EU (US$ 58 million) reached its highest value in 2012; but this value fell far below that of the AD economies during the same period (Figure 4.9). By the WITS classification, garment and textiles machines form a major component of the industrial machine importation data. This comprises of industrial and small scale sewing machines. The industrial and small scale sewing machines are respectively used at the large and small scale level of garment production. I discuss the importation of small scale and industrial garment machines in Section 4.10.2 and 4.10.3 respectively.

Figure 4.9: Trends in the imports of industrial machines into Uganda (millions of US$)

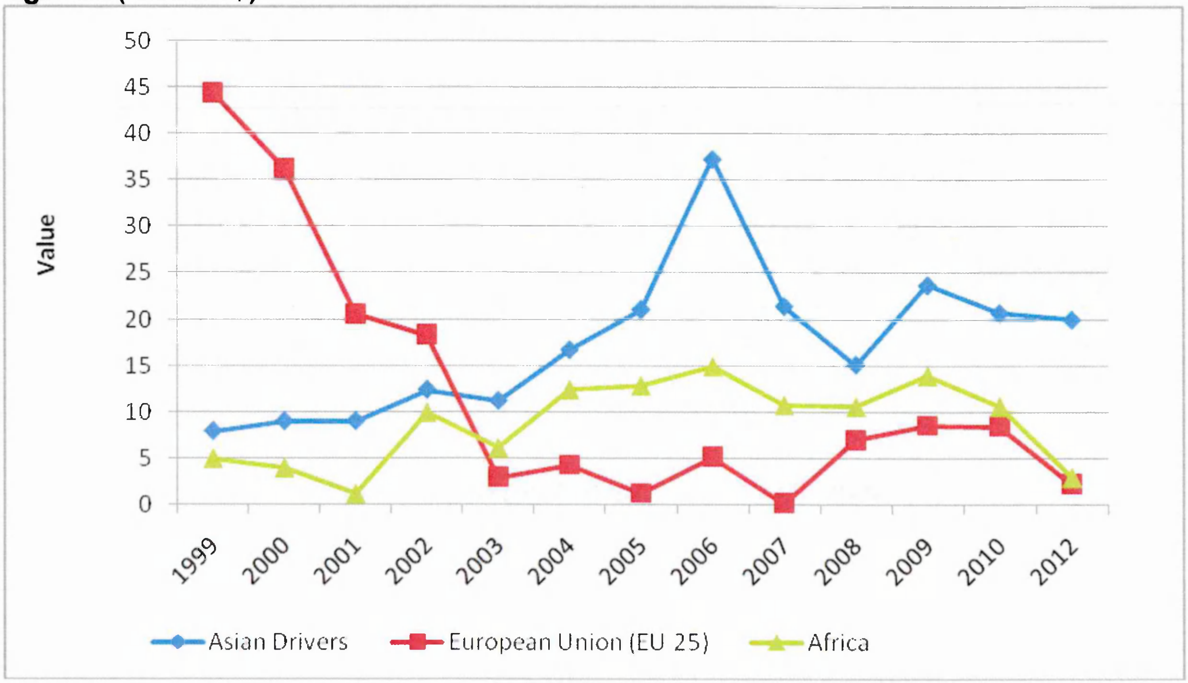


Source: WITS-COMTRADE, SITC 3, Product Code 72, Accessed 17/03/2014

4.10.2 Sources of imports of small scale sewing machines

Figure 4.10 illustrates the sources and value of imports of small scale sewing machines into Uganda. Until 2002, the EU remained the most important source of these machines into Uganda. However, the gradual rise in value of small scale sewing machines imported from the AD economies (i.e. China and India) has made them the leading sources of small scale sewing machines into Uganda. The value of imports of AD originated imports of small scale sewing machines rose from US$ 6,500 in 1999 to US$ 20,000 in 2012 (Figure 4.10). This surpassed imports of small scale garment making machines from SSA (Figure 4.10). On the other hand, the value of small scale sewing machine imports from the EU declined from almost US$ 45,000 in 1999 to US$ 2000 in 2012 (Figure 4.10). This may be attributed to the growing decline in demand for small scale sewing machines from the Western economies. I will make a detailed discussion on this growing decline in demand of the Western machines later in Chapter 6 of this study.

Figure 4.10: Trends in the import of small scale garment making machines into Uganda ('000 US$)

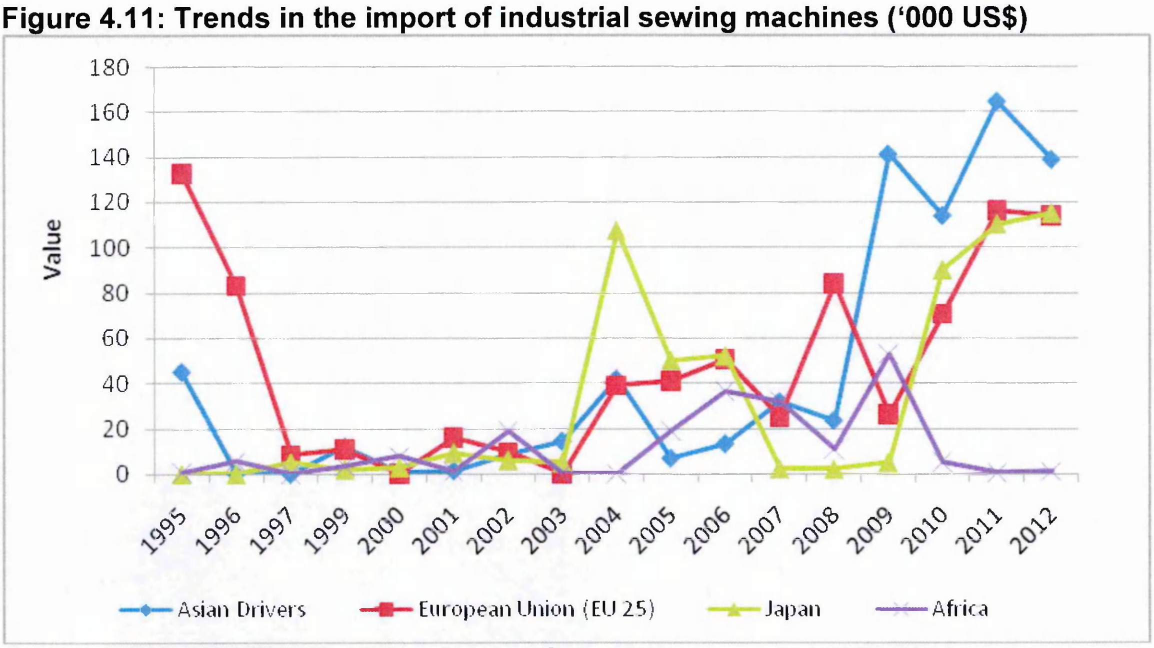


Source: WITS-COMTRADE, SITC 3, Product Code 72433, Accessed 17/03/2014

4.10.3 Sources of imports of industrial sewing machines

Figure 4.11 presents the trends in the imports of industrial sewing machines into Uganda. Similar to the small scale garment making machines, import values from the AD economies (i.e. China and India) were the highest for the period between 2009 and 2010 (Figure 4.11). The EU and Japan also play a significant role as the source of imported industrial sewing machines into Uganda. In 2012 for instance, Uganda imported US$ 115,000 worth of industrial sewing machines each from EU and Japan (Figure 4.11). Imports from the AD economies (i.e. china and India) however, rose to US$ 140,000 in the same year (Figure 4.11). Other African economies, particularly Kenya and South Africa also have until recently played a very significant role as a source of import of industrial sewing machines into Uganda (Figure 4.11).

Figure 4.11: Trends in the import of industrial sewing machines ('000 US$)

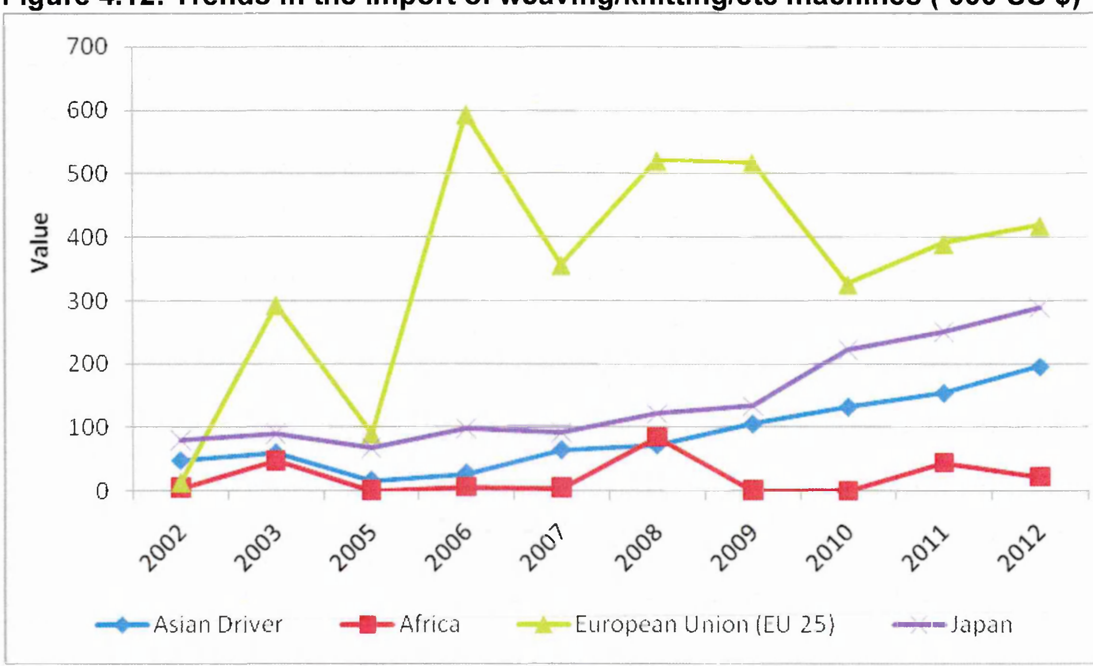


Source: WITS-COMTRADE, SITC 3, Product Code 72435, *Accessed 17/03/2014*

4.10.4 Sources of imports of weaving/knitting/etc machines

As I will cogently explain later in Chapter 5 below, the importance of weaving and knitting in garment production cannot be ignored, particularly when it comes to value addition to the garment (Carr and Pomeroy, 1997). Figure 4.12 below shows the trends in the value of imports of weaving, knitting machines, etc, into Uganda. Unlike the industrial sewing machines, the Western economies are the most important source of weaving and knitting equipment. The value of knitting and weaving machine imports from the EU increased from US$ 14,000 in 2002 to US$ 418,000 in 2012 (Figure 4.12). Similarly imports of Japanese weaving and knitting machines also rose from US$ 80,000 in 2002 to US$ 289,000 in 2012 (Figure 4.12). Though the value of imports from the AD economies continues to rise, it is far lower than that of EU and Japan. For instance in 2012, the value of weaving and knitting machines that were imported from the AD economies was US$ 196,000 (Figure 4.12).

Figure 4.12: Trends in the import of weaving/knitting/etc machines ('000 US $)



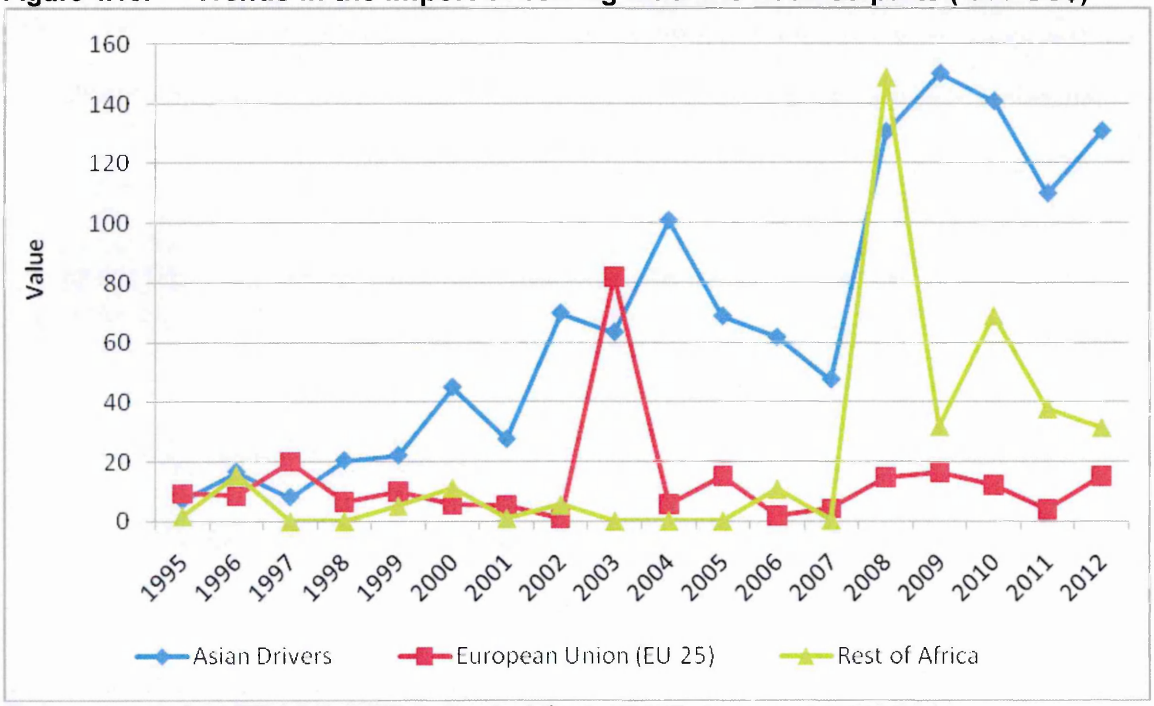
Source: WITS-COMTRADE, SITC 3, Product Code 7245, Accessed 17/03/2014

4.10.5 Sources of imports of sewing machine parts into Uganda

Figure 4.13 below shows that the value of imports of sewing machines, needles and its parts from the AD economies (i.e. China and India) has surpassed those from the EU and other African countries like Kenya and South Africa. The value of imports of AD originating sewing machine parts increased from US$ 28,000 in 1995 to US$ 130,000 in 2012 (Figure 4.13). What is interesting is that between 2009 and 2012, the values of AD spare parts import appeared to be higher than the value of domestic sewing machine imports but almost at the same level with the value of the industrial sewing machines imported from the AD economies. This may partly be due to the frequent replacement of

AD economies needles and other parts. Later in Chapters 5 and 6 of this study, I will show that the frequent breakdown of the AD sewing machines and low cost nature of the AD spare parts is the main inducing factor for their higher imports.

Figure 4.13: Trends in the import of sewing machine needles/parts ('000 US$)



Source: WITS-COMTRADE, SITC 3, Product Code 72439, Accessed 17/03/2014

4.11 How do the ADs fit into the garment sector in Uganda?

As the forgoing discussion demonstrates, the role of the AD economies in the garment and textiles sector in Uganda cannot be ignored. First, the AD economies are increasingly becoming the sources of finished garments and textiles to Uganda. As indicated above, the value of garment and textiles imports from the AD economies increased from US$ 1 million in 1998 to US$ 38 million in 2012 (see Section 4.8.3). This surpassed that of the country's traditional sources of imports (see Section 4.8.3). However, the influx of relatively cheap textiles and garment from the AD economies is crowding out local garment producers in Uganda. Garment producers in Uganda have found it extremely difficult to compete with the low cost alternatives from these countries because they are appealing to many low-income earners.

Second, similar to any other African country that took advantage of the AGOA and EPA, Uganda has been outcompeted by the growing presence of AD originating garment and textiles on the international market. This was as a result of the closure of the MFA and ATC. It is, however, unmerited to blame the garment and textile crisis entirely on the AD economies. These countries have strategically capitalised on their comparative advantage of cheap labour and technological advancement. Over-dependence on preferential treatment afforded by AGOA made the country neglect other untapped markets such as South America (Thoburn, 2009).

Thirdly, prices of garments and textiles produced in Uganda are uncompetitive. This is mainly because of the high cost of production in the country and the high demand for cheap Chinese garments imports into the country (GoU, 2008). As a result, the demand for AD originated garment products has soared at the expense of locally produced goods. Even Africa's traditional export markets have now also succumbed to the AD economies' domination in the garment and textile industry. While the economic activities of AD based companies may stimulate local development to an extent, their dominant presence has stirred up some resentment amongst the locals. For example, Chinese clothing manufacturers in Kampala have been under fire for failing to meet legal minimum wage and working conditions (Matisko, 2012). There also exists a strong presence and influence of labour unions in Uganda, which often exacerbate existing tensions in their bid to protect the workers' welfare. The recent emergence and escalation of garment products printed with traditional Ugandan designs but that's reproduced in the AD economies has also contributed to the strained relations between the two parties. This was a profitable niche market segment that Ugandan producers enjoyed and dominated as Ugandan prints were in demand not only in the East African region but also in Western countries. Now the AD based companies have also entered this market and are actively competing in the same market. The manufacturing of Ugandan prints in the AD economies is seen as an insult to the Ugandan people and manufacturers who feel rights to commercial enterprise based on Ugandan cultural heritage should remain in the country.

4.12 Conclusion

This chapter has profiled Uganda and the garment sector with an emphasis on the capital equipment in the garment sector. The chapter concludes that the services sector is the largest contributor to GDP but the agricultural sector remains the biggest employer in the economy. The chapter further concludes that majority of the Ugandan labour force are unskilled, though majority of the newly created jobs are skills intensive—particularly in the industrial and services sectors. This creates a barrier for employment for a large proportion of the labour force in the country. Unemployment is high in urban communities; however, there is a higher incidence of poverty and inequality among Ugandans in rural location. This is affecting income distribution considering that 85 % of Ugandans live in rural communities. This chapter further concludes that poor road infrastructure and unreliable energy creates difficulties for some types of advanced technologies and this contributes to low productivity. Furthermore, the AD economies are now the main source of garment—making technologies into the country. The downside of the rise of the AD economies for developing countries like Uganda is that they are also serving as a source of cheap garments; and these cheap garments are of high demand on the Ugandan market. This ends up outcompeting local garment producers in the country.

CHAPTER 5: GARMENT PRODUCTION OPERATIONS IN UGANDA

5.0 Introduction

As indicated in chapter four above, this chapter and subsequent chapters will only focus on AD and Western made garment making machines since data on AD textile machines in the country are not enough for any meaningful research work. This chapter describes the operations involved in the production of garments at the small[6] and large[7] scale levels in Uganda. I do this in the context of the forms and sources of technology—hard and soft technology—at each stage of the production process. The study shows that whereas small scale garment production is a one-off process, large scale production is serialised. Production at the large scale level depends solely on energy infrastructure. However the use of energy infrastructure at the small scale level depends on the location of the technology. Small scale productions in rural communities use manual garment making machines and those in urban communities[8] use machines that are mostly driven by electric energy. I also argue that large scale garment production is buyer driven, in the sense that the specifications of the buyer partly determine the type of garment making machine that must be used for production.

The chapter is divided into four main sections. Section 5.1 differentiates between the operations involved in small scale and large scale garment production. Section 5.2 describes the operations and related technologies required for garment production at the small scale level. I focus on large scale production in Section 5.3. Section 5.4 concludes this chapter.

---

[6] This study adopts the International Labour Organisation (2002)'s definition of a non-agricultural firm with an average of 1 to 49 employees as small scale. This term is also used in a broad sense to include micro firms as well.

[7] The study considers all firms that employ more than 50 workers as large scale. Note that some definitions consider a firm's capital outlay, technical expertise etc when defining the size of a firm but due to limited data availability, the study considers employment as the key definitional criterion.

[8] Some of the small scale producers in urban areas also use manually driven technologies but they are in the minority and this will be discussed in detail in subsequent chapters.

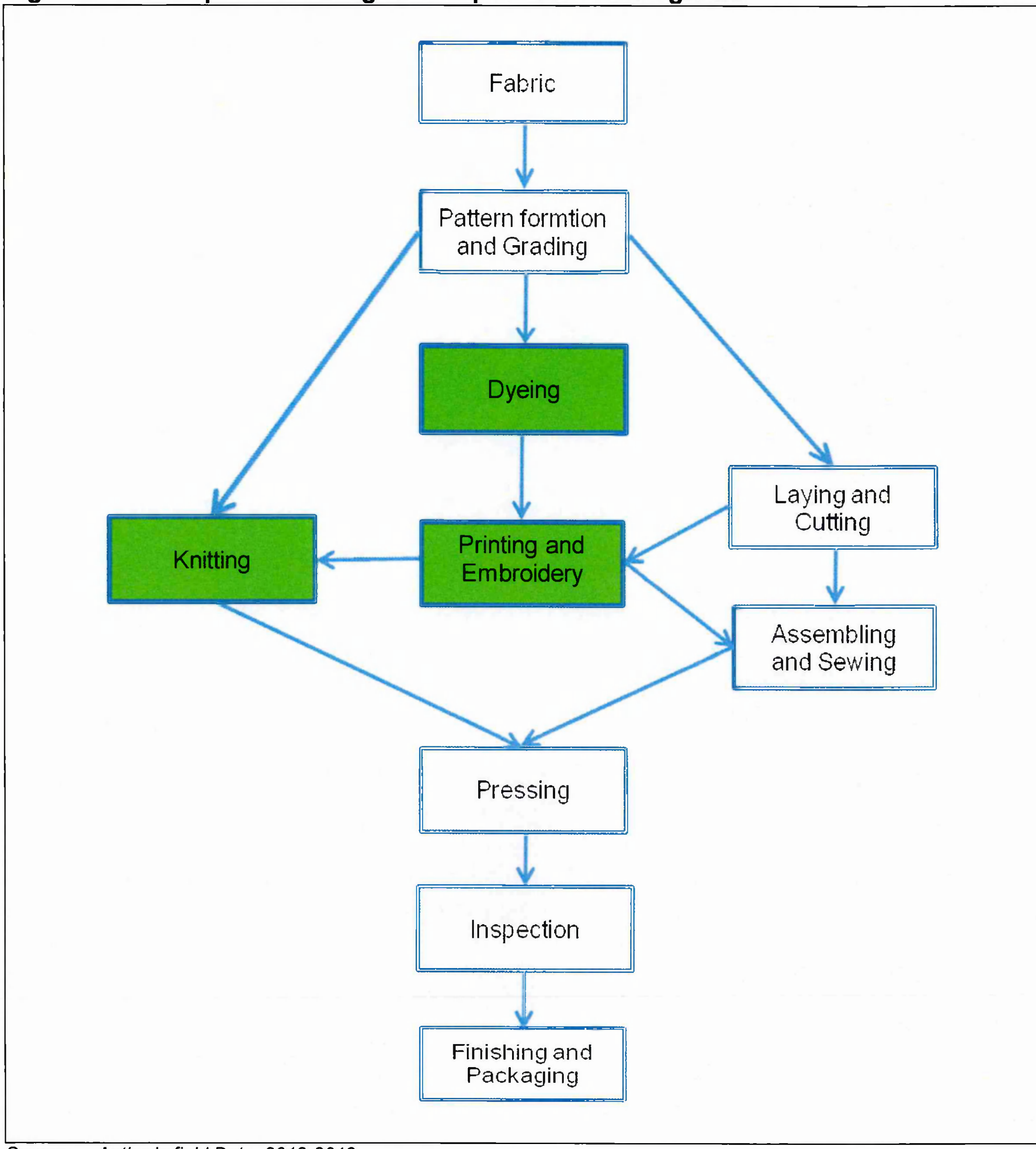
5.1 The difference between large and small scale garment production operations

Garment production in Uganda involves 3 main stages—pre-sewing, assembling and sewing and post-sewing. The principal activities at the pre-sewing stage are marker planning, pattern formation and nesting, grading, dyeing, cutting and laying (Figure 5.1). The sewing stage includes assembling and sewing, knitting and embroidery (Figure 5.1). The post sewing stage involves printing, pressing, inspection, finishing and packaging, and then delivery to the client (Figure 5.1). My field data shows that activities at the small scale level are a one-off process in which one operator is responsible for all operations. However, large scale garment production apportions each activity to a separate department (based on field interviews in 2012). This makes large scale production a serial process with each department having a supervisor who ensures that production is done to meet buyers' requirements. The serial production leads to the division of labour and flexible skills specialisation in each department. The production manager of Christex Garment Industry; a leading local large scale firm in Uganda indicates that

> *"we allow them* [workers] *for at least 1 year to gain all the skills in one department before moving them to another department......we do that to allow them get enough experience..... to ensure that they can be all round workers....it is better because whenever a worker is absent in a department, we are able to get another worker to operate the machines in that department".*

Activities such as dyeing, knitting, printing and embroidery are rarely performed on commercial scale at the small scale level.

Figure 5.1: Operations in garment production in Uganda



Source: Author's field Data, 2012-2013
NB: The shaded areas are activities that are not performed at the small scale level

Another important difference is that the large scale garment firms use relatively automated and computerised technologies, and produce on a large scale whereas the small scale producers use simple and mostly manually driven garment making machines for their activities. In Sections 5.2 and 5.3 of this chapter, I will discuss the characteristics of the machines by their source of manufacture (whether from the AD or Western economies). Furthermore, large scale garment production is only undertaken in the urban communities where there is electricity infrastructure but small scale production is done in both urban and rural communities.

Lastly, garment production at the small scale level is performed by only local entrepreneurs in Uganda. However, there are foreign investors who compete with local entrepreneurs for contracts at the large scale level. Table 5.1 below summarises the above discussion and places the remaining discussion in the context of these differences. In the next two sections of this chapter, I will make a detailed discussion on the operation involved in large and small scale garment production. This will be done in the context of the presence of technologies from the AD and Western economies.

Table 5.1: Summary of the differences between large and small scale garment operation in Uganda

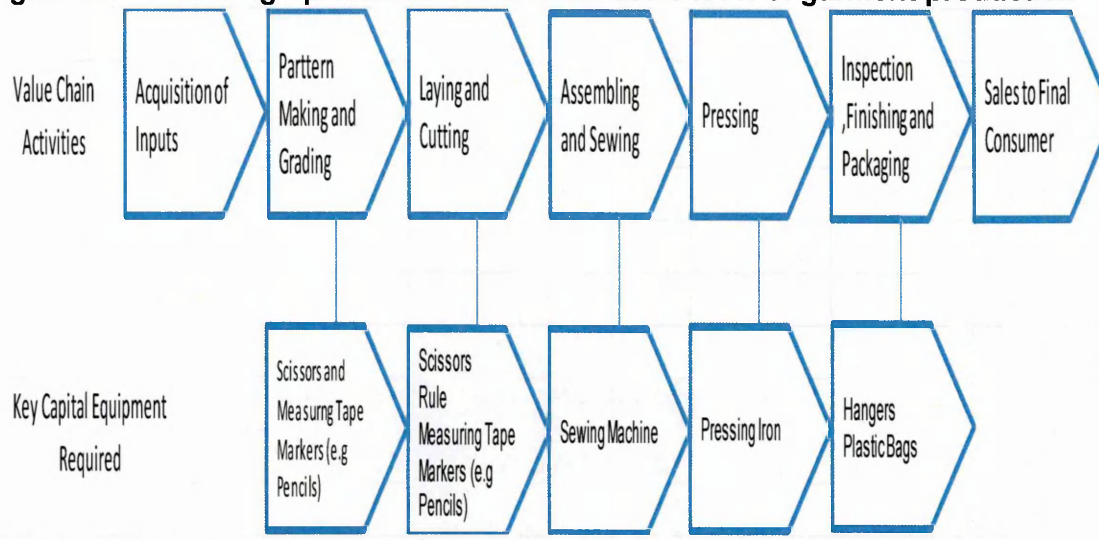
Small Scale	Large Scale
Production is a one-off process	Production is a serial process
Producers use simple and mostly manually driven technologies for their activities	Producers use relatively automated and computerised technologies
Production is based in both rural and urban communities	Production is based in the urban communities
Mainly the preserve of local entrepreneurs	Foreign investors from the AD economies and Western as well as local entrepreneurs are all involved in the production

Source: Author's fieldwork compilation, 2012-2013

5.2 Garment production operations at the small scale level

Figure 5.2 below graphically outlines the operations involved in the production of garments at the small scale level which I will now discuss in more depth. The process starts with the acquisition of inputs and ends with the final consumer. I describe the garment making machine that is used at each stage of the garment production process. I describe each of these stages below.

Figure 5.2: Sewing operations at the small scale level of garment production



Source: Author's field Research work, 2012-2013

5.2.1 Pre-sewing stage at the small scale level

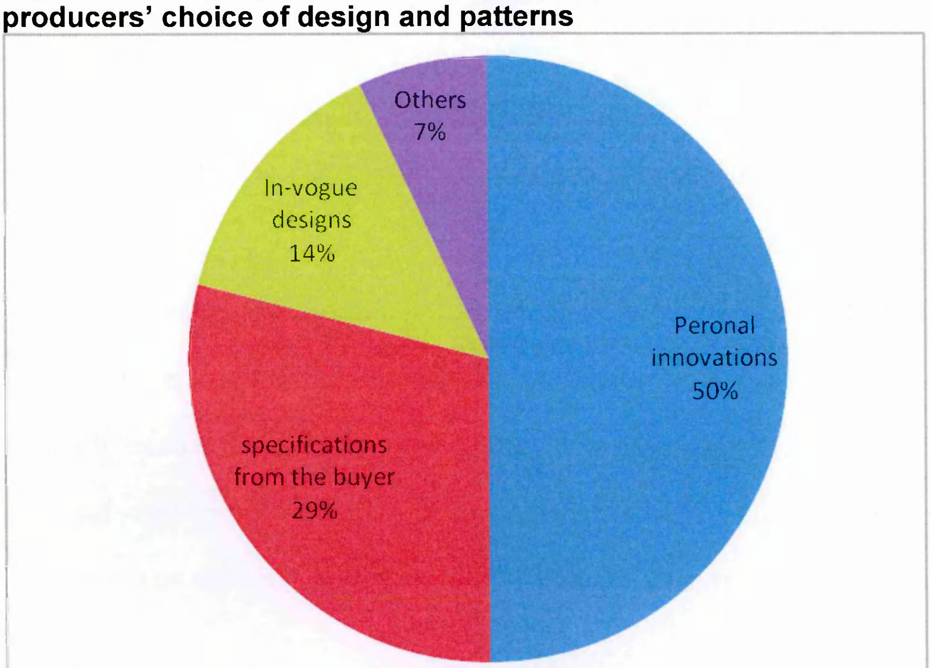
I. Marker planning, design and pattern formation

Marker planning is the conceptualisation, intuitive, open and creative process in garment production (Hoffman and Rush, 1988). This is an important prerequisite for designing, pattern formation and nesting (Hoffman and Rush, 1988). Carr and Latham (1994) show that good marker planning results in efficient use of the fabric. Pattern formation and design are important for determining the level at which buyers will accept the garment (Carr and Latham, 1994). Competences in soft technology in the form of creative skills in marker planning are pertinent at this stage of garment production. A small scale garment producer requires a lot of creative work in order to present the best patterns and designs that can attract more customers in the competitive garment production sector. The Chairman of the Kiyembe Tailors' Association explains that

> "*we don't get orders like Nytil or Phenix* [i.e. two leading large scale firms in Uganda]...... *so we do* [Sew] *a very good design for customers to like* [in order to attract more customers] *that is the only way you can make profit.... if you are not creative you can't get customers".*

The 147 small scale garment producers surveyed for this study were requested to respond to the question "what is the most important factor that influences the type of design and pattern you make on a fabric?" Figure 5.3 below shows that out of the 147 small scale producers that were interviewed, 50 % rely on their personal innovations as the most important consideration to develop a design and pattern. Only 29 % of the garment producers follow strictly the specifications of the buyers to develop the designs and patterns on the garment they produce (Figure 5.3). 14 % also rely on fashion designs that are in vogue to develop their designs and patterns (Figure 5.3). They get these in vogue designs and patterns from magazines, posters and other relevant documents. Thus, garment production at the small scale level does not always follow the specifications of the buyers. Therefore as indicated in Section 5.1 above, buyers' influence on small scale garment producers is minimal relative to large scale producers, as will be discussed in Section 5.3 below.

Figure 5.3: Responses on the most important factors that influence garment producers' choice of design and patterns



Source: Author's Field Data, 2012-2013

The garment producers employ simple working aids such as markers (e.g. pencils) and tape measures (Figure 5.2). All the working aids that were identified are AD made and they are readily accessible on the local market in Uganda. The Chairman of the Kiyembe tailors association explains that

> *"all these things* [pre-sewing working aids] *are all from China.....they are very cheap and easy to find everywhere in this market...I don't see any British or American types* [Western made] *here these days....they are not common".*

The small scale producers' use paper markers to plan their markings for garment production. The issue is that paper markers make designing, pattern making and nesting more cumbersome and prone to errors since it becomes difficult to make changes to the patterns and designs (Hoffman and Rush, 1988). This has implications on the amount of value that is added to the garment and may also compromise the ability to meet delivery deadlines of valuable clients. This issue is more pronounced in rural communities in Uganda. I will show in Chapter 7 of this study that using paper markers in rural communities partly contribute to delays and lower value addition to the garment produced.

II. Laying and cutting

Laying and cutting of the fabrics are the final activities at the pre-sewing stage of garment production (Figure 5.2). These activities require a lot of care to ensure accurate cutting of the fabric to suit the garment pattern and design. Chinese made scissors are the most pervasive on the local market (Figure 5.4) they are very simple to use and less capital intensive. The issue is that it is laborious, and time consuming to use a pair of scissors to cut thick fabrics (Carr and Latham, 1994). A few small scale producers in the cities also employ German made electric cutters for this operation (Figure 5.5). Though it is capital intensive, the German made electric cutter operates faster and cuts fabrics to more precise specifications than a pair of scissors. The German technology is also desirable for cutting thicker and multiple layers of fabrics. A member of the Kasese Tailors Association indicates that

> *"I like this cutter* [i.e. German made electric cutter] *because it has a very strong blade....it can cut several layers of thick fabrics....just that it is not common...."*

Figure 5.4: Chinese made scissors

Source: Author's field Data, 2012-2013

Figure 5.5: German made rotary knife

Source: Author's field Data, 2012-2013

5.2.2 Assembling and sewing stage

Assembling and sewing of garments commences after the completion of the process of laying and cutting (Figure 5.2). Although the fabric must be cut before sewing, and pressed after it has been sewn, it is the process of sewing that dominates the output of a garment firm irrespective of the firm size. Carr and Latham (1994) identify the objectives of sewing to be the construction of seams which combine the smooth fabric joins with even stitches in such a way that there will be no damage to the fabric. Furthermore, it ensures that the seams define the achievement of strength, elasticity, durability, comfort, as well as the maintenance of any specialised fabric properties (Carr and Latham, 1994).

The sewing machine is the key capital equipment used at this stage (Figure 5.2) and is no more than a power[9] operated needle with other mechanisms in synchronisation to produce a series of stitches continually. In their book titled *Productivity in Sewing Operations*, Grills and Brown (1975) indicates that the sewing machine is the most valuable capital equipment in terms of adding value to the fabric. Carr and Latham (1994) also state that the sewing machine is key in achieving good appearance and performance in seams, as well as ensuring that the joins of the fabric are either smooth

[9] Power in this sense can be energy driven or man-power.

and unobtrusive or evenly eased or gathered to suit the requirements of fit and style. The above functions of the sewing machine as described by Grills and Brown (1975) and Carr and Latham (1994) play a significant role in determining the choice of sewing machine technology for garment production. Hence, I will use the sewing machine as a case study to estimate the private and social profitability of garment making machines in Chapters 7, 8, and 9 respectively. There are two main types of sewing machines for small scale garment production—the hand operated sewing machines and treadle sewing machines. The hand-operated sewing machines operate manually and are the cheapest and simplest form of sewing machines (Figure 5.6).

Figure 5.6: Chinese made hand operated sewing machine

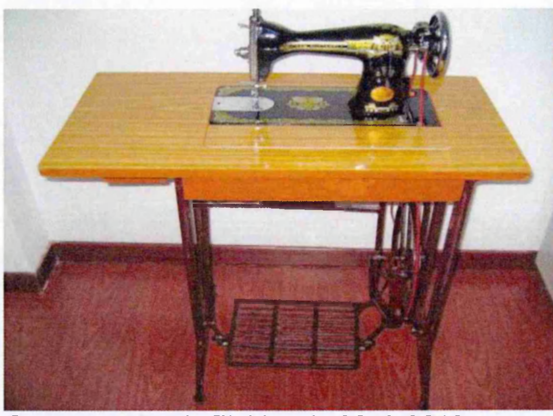
Source: Author's Fieldwork 2012-2013

They are portable and common at the household level for mending garments. The study identified few hand operated sewing machines at the small scale garment production level. These hand operated sewing machines are mostly Chinese made sewing machines. The treadle sewing machine is similar to the hand operated sewing machine, but it requires the feet and an additional stand to complement the hand to operate. There are both Western made treadle sewing machines (WSMs) and AD made treadle sewing machines (ADSMs). There are both electric and manual treadle sewing machine in the Ugandan garment sector (Figures 5.7 and 5.8). My field data shows that those that do not use electric power are manually driven, and are mostly used in rural areas where there is no energy infrastructure. The electric treadle sewing machines on the other hand are mostly used in urban areas. However, the manually driven Asian Driver treadle sewing machines (ADSMs) are more efficient in rural areas than the Western made ones. A garment producer in Kasese explains that

> *"I will always prefer the British sewing but this machine* [AD sewing machine] *is very good and fast.....it is not heavy like the British one......".*

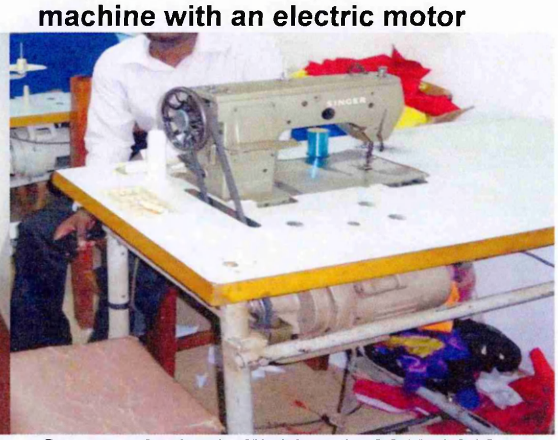
Later in Chapters 7, 8 and 9, I will provide more detailed quantitative evidence to support the differences in returns of the two alternative sewing machines.

Figure 5.7: AD treadle sewing machine sewing



Source: Author's Fieldwork, 2012-2013

Figure 5.8: Western made treadle machine with an electric motor

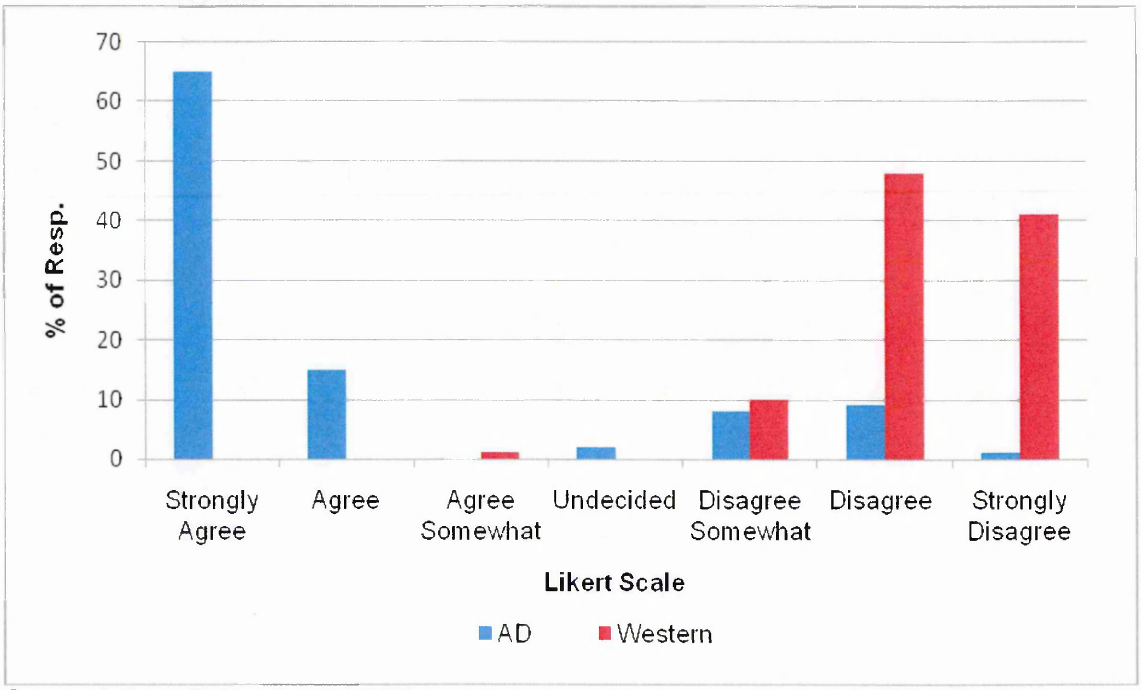


Source: Author's Fieldwork, 2012-2013

It is difficult to operate the manual WSMs (Figure 5.8) because they are bulky in nature; hence the operator needs to exert a lot of force on the foot pedal in order to sew faster (Figure 5.8). The electric powered WSM produces more garments than the ADSM. Later in Chapters 7 and 8 I will compare the output levels of the two machines as a result of infrastructure differences in urban and rural areas. The treadle sewing machines are the most common machines at the small scale level. The choice of fabric for the production of garments and the quality of stitches partly depends on the nature of the sewing machine as well as the skills and experience of the garment producers. Similar to the issue pertaining to infrastructure requirement I will explore the quality differences of the two sewing machines in Chapters 7 and 8. In general, ADSMs skip stitches and record frequent needle breaks when sewing thick fabrics. Unlike the WSMs, it is very simple and easier to use in locations without energy infrastructure.

Figure 5.9 presents likert scale scores of the 147 small scale garment producers on a question that aimed at comparing the machine operators' preferences for ADSMs and WSMs when it comes to needle breaks and stitch skips. The likert scale ranged from one (strongly agree) to seven (strongly disagree). In general the likert scale score in Figure 5.9 shows that the garment producers experience more needle breaks and stitch skips with the ADSMs than the WSMs. 65 % and 15 % of them respectively strongly agree that the ADSMs skip stitches and records frequent needle breaks (Figure 5.9). On the other hand, the majority of the garment producers who were interviewed indicate that they disagree or strongly disagree that the WSMs skip stitches and record frequent needle breaks (Figure 5.9).

Figure 5.9: Tendency of sewing machines to encounter stitch skips and needle breaks



Source: Author's Fieldwork, 2012-2013

This defect on the ADSMs leads to weak seams and reduction of value added as well as quality of the garment. In consequence, garment producers prefer to use WSMs for the production of garments that are relatively expensive and/or thicker in order to avoid weaker seams and subsequent damage to the fabrics. However, the ADSMs are very simple and easier to use in locations with no energy infrastructure. This confirms the assumptions in the literature that AD made technologies are tolerant to weak infrastructure (Clark *et al.* 2009; and Kaplinsky, 2010 and 2011). In the next chapter I will show that despite this demerit associated with the AD treadle machines they remain the most distributed technology at the small scale level.

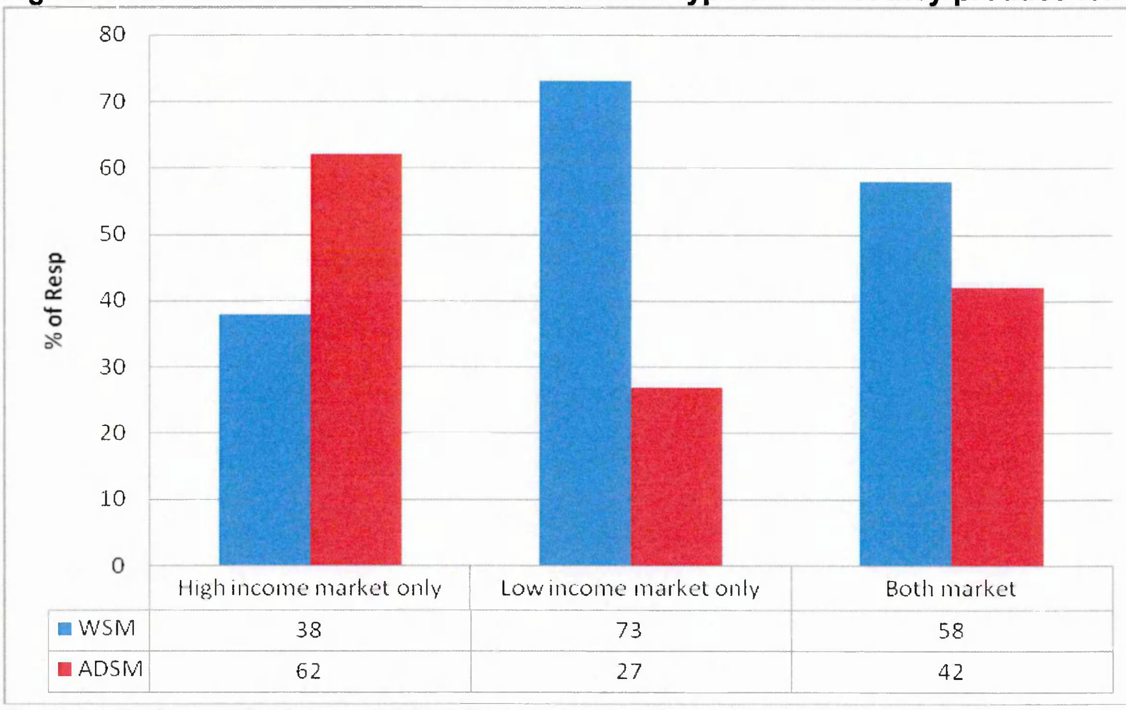
These attributes of the ADSMs and WSMs partly influence the type of sewing machine that a producer may employ for a particular market. Figure 5.10 illustrates the type of market operators of AD and Western made garment making machines produce for. Consumers in the high income market are the middle to high income urban elite. They include civil servants and other formal sector workers. The low income markets are located in both rural and urban areas, but they are more present in rural areas. 62 % of the producers selling into only higher income markets[10] use the WSM for production (Figure 5.10). In contrast 73 % of the producers who produce for only low income markets use ADSMs (Figure 5.10). Thus, urban elites' growing demand for quality garments in Uganda influences some garment producers in urban communities to adopt WSMs for sewing. A garment producer in Kampala indicates that

> *"My customers are mainly bankers* [high income market] *I use this sewing machine [a British Singer machine] it produces smooth stitches....it adds a lot value to the garment".*

This does not entirely support the literature that consumers in developing countries are prepared to sacrifice quality for function.

[10] High income markets are the urban elite consumers who acquire garments from boutiques, retail and wholesale shops, middle income earners such as corporate workers, businessmen, and graduates who demand for custom made garments, etc.

Figure 5.10: Users of ADSMs and WSMs and the type of market they produce for



Source: Author's Field data, 2012-2013

5.2.3 Post-sewing activities

The post-sewing stage activities are pressing, inspection and packaging. The main objectives for pressing fabric during sewing are to create creases where the design of the garment requires them. Pressing also smooths unwanted creases and crush marks from the fabric (Carr and Latham, 1994). It is also crucial for preparing the garment for further sewing as well as moulding the garment to suit the contour of the body (Carr and Latham, 1994). All the small scale garment firms that were sampled in urban areas use electric pressing irons to press their garments. There are both AD and Western made pressing irons. On the other hand, small scale garment producers in rural communities use coal fired pressing irons for such activities. The coal fired pressing irons are AD made. They are low cost but the operator cannot regulate the amount of heat that it produces. In consequence, they cause more damage to garments than the electric pressing iron. Finally, the producer inspects and packages the garment for the market. I now proceed to ascertain the operations in large scale garment production in Section 5.3.

5.3 Operations at the large scale level of garment production

As indicated in Section 5.1 of this chapter, the large scale garment producers employ automated and computerised technologies for production. Automation and computerisation in garment production have been at the centre of technological change in garment production (Hoffman and Rush, 1988). Changes in the type and function of technology has made large scale garment manufacturing more efficient in the sense that it has partly contributed to speeding up the production process and enabling firms to make maximum use of the fabric (Hoffman and Rush, 1988). I also explained in Section 5.1 that large scale garment production is a serial process and departmentalised. I now proceed to discuss all the serialised operations by comparing the presence of expertise and technologies from the AD and Western economies at the pre-sewing, assembling and sewing, and post-sewing stages of the production process.

5.3.1 Pre-sewing activities at the large scale level

I. Marker planning, pattern design and grading

The AD and Western owned large scale firms in Uganda use Western made computer-aided design (CAD) software for marker planning, pattern designing and grading activities. The Western made computerised system allows for more efficient pattern formation, design and nesting of the garment. This is because it allows the producer to grade the patterns of the garment according to the specifications of the consumer (Aldrich, 1994). It also ensures accuracy of the exact dimensions of the pattern of the garment and allows garment producers to operate faster with much flexibility and modification of the patterns so as to achieve a desirable requirement (Carr and Latham, 1994). The computerised process also allows the garment producers to store data—hence reducing the time cost for pattern formation if the same pattern is to be repeated for garment production in the future (Aldrich, 1994). Again, it allows easy changes to sizes, automatic recalibrating the planning and cutting stages (Aldrich, 1994). With the foregoing, the CAD software generally makes the above listed activities more efficient to undertake.

The CAD software allows for flexibility in adjusting to the preferences and specifications of the buyers. Interviews with the large scale firms show that both the AD and Western firms produce for the local market and clients in neighbouring countries like South Sudan, Democratic Republic of Congo, Rwanda and Burundi. Similar to the small scale garment firms, the local large scale firms use paper markers for marker planning. Thus they also employ experienced local employees to undertake these important activities. Therefore similar to small scale garment production, soft technology in the form of creativity skills is very important. However, paper markers causes delays and also leads to inaccurate measurement which can eventually affects the quality of the garment (Section 5.2.1). Furthermore, they easily lose data when there are damages to the paper markers. The production manager for Kwera Garments, a leading local garment manufacturing firm in Uganda indicates that

> *"we use paper for the designing…it is cheaper.....but it takes too much time and when the designer makes a mistake we have to correct it or sometimes do it all over again... and it is difficult........we don't have the resources to buy the software...it is really expensive".*

The use of CAD equipment but also the continued use of human designers brings to the fore the importance at this stage of soft technology – expertise – and not just the hard technology markers—computers. For instance, my fieldwork shows that the employees who use the CAD software are educated and have the skills and experience in using computers. They have the competence to install the CAD software on various CAD equipments and operate them (field interviews, 2012).

II. Laying and cutting at the large scale garment production level

Apart from an efficient pattern formation process, the pattern cutter has the greatest responsibility to ensure efficient use of the cloth (Cooklin *et al.* 2011). This requires the development of skills and expertise. At the commercial level, the firms cut many layers of fabric at a time. This activity is performed by strictly following the patterns and designs that the buyers provide. Both AD and Western owned firms mostly use Western made cutters. This is mainly because they have strong non-corrosive blades. A machine operator at Sigma Knitting Company – a Western owned firm - indicates that

> *"the cutter machines from Europe have thicker* [Stronger] *blades that can cut more than 30* [layers of] *fabric at once.....the China blades are weak...so you have to reduce the quantity otherwise it will break".*

However, it is difficult to access spare parts particularly the blades of the Western made cutters on the local market. Interviews with the Western-owned firms show that they import them from Europe, South Africa and Kenya. The CEO of Sigma Knitting Company explains that

> *"few companies use these type of cutting machines in Uganda....if someone imports them to sell, he will not make profits because no one will buy it* [them]*.....so we import them from South Africa or Kenya".*

In contrast, the local firms use AD originated blades for the same activity. As indicated above, the AD made cutters are cheaper but with weaker blades. Unlike the Western made cutters, the spares of the AD made cutters are readily available on the local market. Both the foreign and local firms use the band knife for cutting specialised parts such as collars, cuffs and pockets of the garment (Figure 5.11). They complement it with the straight cutters to cut larger quantities of fabric with the same pattern (Figure 5.12). Thus using these two technologies enable the firms to cut large quantities of fabric at a time. Furthermore, these two knives are appropriate for producing smooth and even cuttings; hence preventing distortion in the component shapes that would result in defective garments (Carr and Latham, 1994). Soft technology is very important in the cutting process. This is because cutting at this level requires a lot of expertise which is developed through the acquisition of skills and tacit knowledge. My field data shows that the Western firms rely on the skills of their experienced expatriate workers for the cutting and laying activities. They do this to prevent or identify and correct all errors that may occur at the marker planning, design and pattern formation stage. The Production Manager for Phenix Logistics indicates that

> *"these two activities are very important for the production.... we can't afford to lose it at this stage.... so I do it myself".*

On the other hand, the AD and locally owned firms employ a local operator for laying and cutting. The production manager for Sigma Knitting indicates that

> *"we....train the local workers on how to use the band knives.....we .....focus more on.... accuracy and speed in cutting during the training....we also train them on safety in cutting".*

Figure 5.11: Band knife

Source: Author's field Data, 2012-2013

Figure 5.12: Straight cutting machine

Source: Author's field Data, 2012-2013

5.3.2 Assembling and sewing

I. Sewing

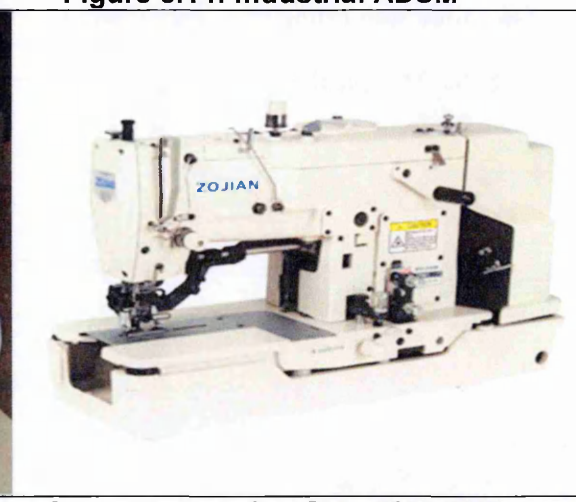
After cutting and laying, the garment producers proceed to assemble and sew the garment. This determines the quality and value of the garment (Aldrich, 1994; and Carr and Latham, 1994). At this level, both the AD and Western owned firms employ industrial WSMs (Figure 5.13) for assembling and sewing fabric. They prefer the usage of the WSMs mainly because they are more durable and can create better quality garments than the ADSMs. Nevertheless, the local firms prefer to use the ADSMs

(Figure 5.14) given that they do not have enough financial resources to acquire enough WSMs. The CEO of Kwera Garments Limited, a local large scale garment producing firm explains that *"I don't have enough capital.....so I always buy the China ones* [industrial ADSMs]*....they are cheaper so I can buy more".*

Figure 5.13: Industrial WSM

Source: Author's field Data, 2012-2013

Figure 5.14: Industrial ADSM



Source: Author's field Data, 2012-2013

The relatively frequent interruption of sewing activity using ADSMs due to needle breaks, rethreading and oiling affects the quality of stitches and also slows down the production process. This particularly happens when producing garments with thicker fabrics (See Case study 1 below). In consequence, it essentially restricts locally owned garment producer firms to produce clothes with thin material. The resultant effect is that the local firms may not be able to compete against their foreign competitors who use WSMs when it comes to bidding for the production of garments with thicker fabric (See Case study 1 below). Nevertheless, the relatively less capital intensive nature of the ADSMs means that they can easily be acquired. Below is a case study (Case Study 1) of Kwera Garments Limited, a locally owned large scale garment production firm based in Kampala-Uganda that discontinued bidding for thicker garments against its competitors but was kept in business as a result of using AD technologies.

Case Study 1: How Kwera Garments used AD technologies to remain in business

Kwera Garments Limited is a wholly locally owned company that obtained its license to operate as a limited liability company in 1994. It is located in Kampala and currently employs 250 temporary workers and 20 permanent workers. The company specialises in the manufacture of institutional uniforms and sports kits. It produces for buyers within and outside the country—Rwanda, South Sudan, Democratic Republic of Congo. In 2008, the Ministry of Defence awarded a contract to three firms to supply it with Uniforms. The firms were Kwera Garments Limited (owned by a Ugandan national), Phenix Logistics (owned by a Japanese national) and Sigma Knitting Limited (owned by an Indian national).This was after all the firms had submitted samples of their product to the Ministry. Kwera was supposed to supply 2,000 uniforms within 1 week after signing the contract document. The buyers furnished the producers with the patterns and designs as well as some technical features that they wanted on the garment. Among other technical features, the buyers wanted an overall green 100 % cotton uniform. The garments were also supposed to be graded in sizes of even numbers ranging from 8 to 18 for men and 6 to 14 for women. In addition, 70 % of the uniforms were supposed to be for men and 30 % for women. Therefore the producers had to resize the original patterns and designs that were provided by their client to be able to get the required sizes by gender. Kwera had 50 ADSMs and 1 band knife. On the other hand, both the other firms were using Western made machines for the production process. All the firms were able to meet the deadlines of their client. However, the garments that were supplied by Kwera started showing weaker seams after a year. In 2009, the Estate Department of the Ministry started reporting feedback it was receiving from its soldiers to Kwera. Weaknesses in seams were the most common complaint that was reported. Kwera realised that the issue was mainly associated with the stitches that their machines produced. They were confident that the problem was not a labour issue since they ensured that their experienced tailors were in charge of that particular production run.

Therefore, the management initially decided to import new WSMs in order to avert this type of issue in future. However, the WSMs were capital intensive. Thus, the firm realised that production of garments with less thick fabric such as school uniforms was of higher demand on the local market. Therefore, the company management took the decision to acquire more ADSMs and abandon bidding for contracts that required the production of garments made of thick fabrics since the ADSMs are able to sew light garments like that the Western made machines. Today, Kwera has more than 200 AD sewing machines and is one of the leading local firms in Uganda and employs graduates. In addition, Kwera has been able to win more competitive bidding processes. This has led to an increase in daily production from 200 garments a day in 2008 to an average of 1000 garments a day in 2012.

Source: Author's Interview with the CEO of Kwera Garments in 2012

II. Knitting of garments

Knitting is the process of forming a fabric by the intermeshing of yarn loops (Brackenbury, 1999). Knitting involves two main methods—the complete and incomplete knitting methods. Complete knitting involves the use of a seamless technology for garment production (Aldrich, 1994 and Brackenbury, 1999). It involves the creation of pieces that are circular or tube-shaped, for example hats, socks, mittens and sleeves. This approach does not incur cut-losses or waste fabric since it is seamless (Aldrich, 1994 and Brackenbury, 1999). The firms use the circular knitting machine for complete knitting (Figure 13).

Incomplete knitting combines the knitting process with cutting and sewing. This method is less costly but adds relatively lower value when compared to the complete knitting approach (Brackenbury, 1999). It is suitable for knitting the front and back of flat pieces like scarves, blankets as well as sweaters. The producers use the flat knitting machine for this activity (Figure 5.16). The flat knitting machine is the most common among the garment producers in Uganda. This is because it is cheaper and relatively less sophisticated.

Both technologies used in this part of the garment making process are Western made technologies—circular knitting machines are produced in Germany while flat knitting machines are Japanese made. However, the cost of maintaining the knitting machines is very expensive particularly the cost of Western made spare parts. An engineer at Phenix Logistics explains that

> *"these machines are very good but their parts are very expensive and scarce.....sometimes when a part spoils* [gets broken] *you need to send the serial number to the manufacturers to manufacture a new one for you and it is expensive.....so you cannot get them on the market here....last month we imported only 2 needle cylinders of our circular machine at the cost of 6000 Dollars".*

A knitting machine is a complex piece of equipment that requires training in order to operate it. As such developing soft technological capacity in the form of skills and tacit knowledge is important for efficient use of a knitting machine. Thus, the entire large scale garment making firms I interviewed – locally, AD and Western owned - provide training for the knitting machine operators. My field interviews show that the local large scale garment firms rely on AD experts to train their local knitting machine operators on how to operate the machines. The Western and AD large scale firms rely on experts from their native countries to operate the knitting machines.

Figure 5.15: Circular knitting machine **Figure 5.16: Flat knitting machine**

Source: Author's field Data, 2012-2013

Source: Author's field Data, 2012-2013

III. Embroidery and printing

At the commercial level of garment production, embroidery and printing activities are important for enhancing the amount of value added to the garment. These two activities also impact on the colourfastness of a garment—an important feature for value addition in garment production. Colourfastness in garment production measures the extent to which the colour of a fabric will not fade with washing or wearing (Carr and Pomeroy, 1997). Embroidery and printing are not compulsory processes but add value to the other stages of garment production (Carr and Pomery, 1997). Though these two activities are not compulsory, they are mostly demanded by the buyers. All the large scale garment producers that were interviewed indicated that they conduct embroidery and printing work.

In order to achieve the greatest quality and efficiency, the firms interviewed invest in computerised embroidery machines that replicate a design repeatedly with precision and speed at low cost. All the AD and Western owned firms, and two out of the five local firms use Western made multi-needle embroidery machines (Figure 5.17). The other three local firms employ AD made single needle embroidery machines for their embroidery activities (Figure 5.18). The multi-needle embroidery machines are suitable for producing similar embroidery designs on a larger scale and that of the single needle is used in a more flexible manner to produce different embroidery designs. The single needle embroidery machine is less expensive but works on one garment at a time (Figure 5.18). It is also time consuming and less productive compared to the multi-embroidery machine.

As indicated in Section 5.1 above, the large scale producers follow strictly the specifications that are set out by the buyers. The types of embroidery design that are specified by the buyers determine the type of machine to be used. For instance, if a buyer specifies that s/he wants a uniform design on the entire garment, the producers will prefer to use the multi-needle embroidery machine. However, if the buyer wants the designs to vary on each of the garments, then the producers will use the single-needle machine to produce these. The production manager for Phenix logistics indicates that

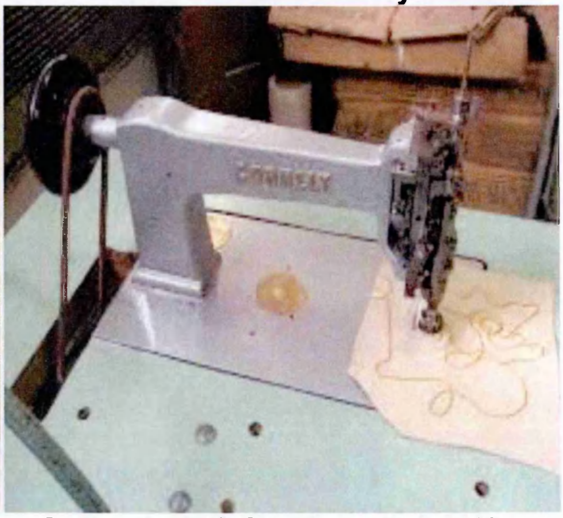
> *"we use these two machines* [the multi-needle and single-needle] *for different purposes though they all do embroidery works....if the garment producer request for few embroidery works.....or sometimes varying embroidery works on each of the garment then we use this small one like sewing machine* [single needle embroidery machine]......*but if we are doing same embroidery works on large scale, then we use this complex one"*

The large scale producers employ screen printing technology for their printing activities (Figure 5.19). Screen printing is the most common type of printing machine at the large scale level in Uganda. All the five local garment firms that were sampled use screen printing machines for their printing activities. They are less sophisticated and simple to use; but time consuming and usually produces prints that easily fade (Figure 5.19). They are made in AD economies. On the other hand the AD and Western owned large scale firms use a Western made digital printing machine for production. It is faster and produces non-fading prints. The colour type requirement a buyer makes determines the speed of each of the machines. For instance, it will take 18 to 30 minutes for a digital printer to finalise the printing of 50 deep coloured shirts or 75 'fade out' shirts. By contrast, an AD made screen printing machine requires an average of one hour to print 10 deep coloured shirts or 25 light coloured shirts.

Figure 5.17: Western made multi-needle Embroidery machine

Source: Author's field Data, 2012-2013

Figure 5.18: AD made single needle Embroidery machine



Source: Author's field Data, 2012-2013

Figure 5.19: AD screen printing machine

Source: Author's field Data, 2012-2013

5.3.3 Post sewing activities

I. Pressing

Similar to small scale garment production, the final activity in garment production at the large scale level is the process of pressing the garment with a hot iron to clear or form creases on the garment depending on the customer's requirements (Carr and Latham, 1994). It is also an essential activity for finishing and packaging of garments (Carr and Latham, 1994). There are both AD and Western made pressing irons at this level. Both are simple to use, but the distinctive feature is that the AD pressing iron weighs less at between 1.0-2.5 kg whereas that of the Western pressing iron is around 2.0-3.5 kg in weight. Thus, working with the Western pressing iron is more cumbersome and vulnerable to power fluctuation than that of the AD originating pressing iron. This is mainly because the Western irons were manufactured to operate in environments where power does not get interrupted. After pressing, the firms inspect, finish and package the garment to ensure efficiency and accuracy at this stage. The garment is then delivered to the customer.

5.4 Conclusion

In this chapter I have made a distinction between large and small scale garment production. I conclude that garment production at the small scale level is a one off process where all the activities are under the supervision of one person. In contrast, each stage of the large scale garment production is under a supervisor. Garment producers at the small scale level use relatively simple technologies compared to those that operate at the large scale level. Furthermore, small scale garment production is conducted in both rural and urban areas. However, due to the energy infrastructural requirement, large scale garment production is mainly found in urban areas. The use of AD technologies of all types has proved valuable for local firms since they are able to expand their business especially when they are capital constrained and cannot afford Western technologies.

This chapter also concludes that the importance of soft technologies cannot be ignored in garment production in Uganda. These soft technologies come in the form of the skills, tacit knowledge and experience required in the operation of garment making machines from both AD and Western economies. This is particularly pronounced at the large scale level where some of the garments making machines are sophisticated to use. For instance, knitting and CAD machine operators at the large scale level require some form of training in order to operate them.

Though the study has established the fact that there are both AD and Western technologies in the garment sector in Uganda, it is important to know the mechanisms of transfer and the extent of distribution of the technologies from both sources—the AD and Western economies. This will unearth the implications of these technologies on poverty in Uganda. I therefore focus the next chapter on the distribution and mechanism of transfer of the technologies into Uganda.

CHAPTER 6: THE DISTRIBUTION AND MECHANISM OF TRANSFER OF GARMENT MAKING MACHINES IN UGANDA

6.0 Introduction

The previous chapter has described the operations involved and the expertise and technologies required for garment production in Uganda. In this chapter, I take the discussion further by focusing on the mechanism of transfer and distribution of garment making machines at the small and large scale level. I argue that the landlocked nature of Uganda makes it difficult for these technologies to be transferred into the country. However, the less capital intensive nature of the AD technologies makes it easier (in terms of cost) for local Ugandans to import them into the country regardless of the size of the production facility and its location. The AD economies and their nationals also play an important role in the transfer of soft technology in the form of skills, training, and knowledge.

This chapter also discusses the distribution of garment making machines in Uganda once they arrive in Uganda. At the small scale level I analyse this by the location of the technology— at the rural and urban level. Large scale garment production is mainly conducted in urban areas where there is energy infrastructure for the efficient operation of the machines. I argue that the spread effect of the AD machines is generally wider and this has implications for job creation and income distribution.

This chapter is organised into seven main sections. Section 6.1 describes the mode of transfer of the technologies at the small scale level into Uganda. This is followed by a discussion on technology transfer through government institutions in Section 6.2. Section 6.3 discusses the mechanisms of transfer at the large scale level. The distribution of garment technologies is captured in Section 6.4. I discuss access to the technologies at the small and large scale level in Section 6.5. I then focus on the spread effects of the machines on income distribution in Section 6.6. I conclude in Section 6.7.

6.1 Mode of transfer of garment making technologies at the small scale level

At the small scale level, I identify two modes of technology transfer into Uganda:

- ✓ Direct imports and marketing by wholesalers and retailers (traders)
- ✓ Government Technical and Vocational Institutions (discussed in Section 6.2)

6.1.1 Direct imports and marketing of garment making machines

Direct importation of garment making machines by traders is the most common mode of transfer at the small scale level. As indicated in Chapter 4 above, Uganda imports garment making technologies from both the AD countries of China and India and Western economies—Germany, United Kingdom and Japan. Direct imports of the technologies are by sea, road and air. The other alternative is to transport the technology directly to Uganda by air (field interviews, 2012).

I. Transport of garment making machines by Sea and Road

As indicated in Section 2.2.1 above, the technology transfer literature has not paid much attention to the challenges in transferring technology into manufacturing sector in landlocked countries. This section provides empirical evidence to fill this gap in the literature. As a land-locked country, the technology is first transported by sea to the Mombasa seaport in Kenya before subsequently being transported by road to Uganda. It takes an average of four weeks for the garment making machines to be transported from the AD economies to Uganda. However, it takes an average of three weeks for importers who import from the Western economies to get the capital goods to the Mombasa seaport in Kenya after which they then have to be transported by road to Uganda. Transport by sea is the cheapest and easiest route to transport garment making machines. According to the spokesperson for the Kampala City Traders Association

> *"the cost of transporting machines by sea can be two times cheaper than air…so you can spend almost US$ 10,000.00 to import a forty footer container full of*

sewing machines [by air] *from the United Kingdom* [by air]*....the same container 0will cost you close to US$ 5,000.00 by sea".*

However, the landlocked nature of the country makes the cost of capital equipment more expensive than its maritime neighbours. This is mainly due to the higher transport cost[11]. According to the Deputy Executive Director of the Uganda Investment Authority, the higher cost of transporting capital equipment into Uganda makes importers incur an average of 30 % more cost than its maritime neighbours—Kenya and Tanzania (Based on my field interview in 2012). After completing all the customs clearing processes, an importer in Uganda will have to travel an average of 1,162 kilometres before reaching Kampala with all the goods. This increases the cost of transporting both the AD and Western technologies and so affects bottom-line prices. Importers have no other option at the moment; since the other alternative through Tanzania (Dar es Salaam) is even more expensive. A spokesperson for the Kampala City Traders Association indicates that

> *"it is very expensive doing import business in Uganda....we pay a total of US$ 1,800 to transport a forty footer container from the Mombasa port to Kampala........we have no choice because it is closer and cheaper than going through Dar* [Dar es salaam]*.......when you import through Dar* [Dar es salaam] *you would have to pay at least an extra $1,000".*

The cost of transporting the two sets of sewing machines by road is the same. However, because the AD technologies are relatively less capital intensive than the Western technologies, transporting them at the same rate favours the Western technologies. Furthermore, Uganda has no control over trade policies of Kenya and Tanzania (e.g. increases in port charges by its maritime neighbours), but these policies can negatively affect the cost of transporting technologies into Uganda. For example, the East African Magazine reported that the Kenyan Revenue Authority had – at the time of my fieldwork—imposed a cash bond on transit goods (The East African

[11] Note that the transport cost includes all other transactions cost that are incurred in the process of transporting the equipment e.g. border charges and corruption.

Magazine, September 15, 2012). This was to deter importers who end up selling their imports on the Kenyan market. This in general increased the cost of trade between Uganda and its international partners (Interviews, 2012). The above evidence agrees with literature that a landlocked country will incur higher costs of transport than its maritime neighbours (see Faye, *et al.* 2004, Arvis *et al.* 2010; Morrissey and Rudaheranwa, 2012; and Milner *et al.* 2013). This study has gone a step further to show the challenges confronting landlocked Uganda in technology transfer.

6.1.2 Role of the AD economies in the transfer of garment making machines

The technology transfer literature does not pay much attention to the role of AD agents in the transfer of technologies to a landlocked country like Uganda (See Section 2.2.1 above). I fill this gap by providing evidence from the Ugandan garment sector. Table 6.1 below shows the distribution of garment making machine importers in Uganda. There are large and small scale importers of garment making machines in Uganda. The small scale importing firms are mainly Ugandan owned. However, firms that import on a large scale basis are mainly owned by those from AD economies. The local importers constitute the largest number but import fewer quantities of machines (Table 6.1). Out of a total of 20 importing firms that were sampled for the study, 16 of them were Ugandan owned firms (Table 6.1). The remaining four firms were AD owned. As I explained in Chapter 2 above, these AD importing firms excludes the Ugandan-Asians and therefore refer to firms owned by Chinese or Indian expatriates. All the 16 local importers import technology from the AD economies and in small quantities when compared to the AD owned importers.

Table 6.1: Number of importers and their sources

	Sources of Machine		
	AD country	Western country	Both
Locally owned Importers			
Number of Importers	16	0	0
Ave. No. of sewing machines per import	100	0	0
AD owned importers			
Number of Importers	1	1	2
Ave. No. of sewing machines per import	500	300	500

Source: Author's field Data, 2012-2013

The AD owned importer firms import garment making machines from both the AD and Western economies. Two out of the four AD importers import from both the AD and Western economies (Table 6.1). They also import larger quantities of the machines than the local firms (Table 6.1). A sales executive at Lida, an AD owned garment machines importer indicates that

> *"we import from the Europe, Japan, Dubai India....China....we import the embroidery machines from India but we get the sewing machines from China, Japan and Europe...... all the garment producers like the Europe machines....but it is very expensive..... you know poverty is high here so people don't buy them much......but those who have money buy them......if you want to do serious business.....then I will advise you buy this machine* [a Western made machine]"

In the face of high import charges at the Mombasa port in Kenya and limited financial resources, the local importers find it difficult to import large numbers of garment making machines into the country. The manager of Cisha Enterprise, a Ugandan owned importer and trader of garment making machines in Kampala explains that

> *"there is no money to import the more of them* [machines]....... *as you can see the machines are not up to 100.....when the machines are high* [expensive] *you pay more port charges and transport cost....this is aside the cost of the machine.....so it is very difficult".*

Though I was unable to interview any haulage company, 12 out of the 16 local importers I sampled indicated that they transport their machines by road through a

Kampala based AD owned company. As I indicated above, these AD firms are those firms originating from China and India. I must acknowledge that there are Ugandan Asian owned haulage companies, however as explained above, this study did not focus on such firms as they are classed by this study as Ugandan. The reason why the importers use the AD owned haulage companies is that they ensure on-time delivery of their goods; therefore are more reliable. The AD owned haulage firms were said to use haulage trucks that were well insured and roadworthy. This avoids truck breakdowns on the road which may lead to delays and in some cases loss of the goods through theft. The manager for Senga sewing machines explains that

> *"the Indian transport companies are more reliable.....you see if you are not careful your goods will get lost on the way...for instance, they will tell you the truck is broken down on the road.....eventually thieves will take away all the goods. As for the Indian companies they will bring the goods directly to you on time. You don't have to be worried when they are responsible for your goods. Just that it is very expensive but their trucks are good and strong on the road".*

Again, as a result of improper paperwork on the Ugandan owned haulage trucks, the Ugandan and Kenyan authorities do a lot of inspection on them to ensure they have all their document right. This consumes time. The AD owned haulage companies on the other hand clear these hurdles faster than that of the Ugandan owned firms. An industrial officer at the MTIC explains that

> *"we attended a workshop in Kenya and this issue came up....we realise that our people* [i.e. local Ugandans] *mostly do not use good trucks and sometimes they don't have proper documentation on their trucks and the customs officials know these Ugandan company. So the customs official usually scrutinise them a lot to make sure they are genuine before they go....this is unfortunate and usually causes a lot of delays at various check points but....what else can we do under the current circumstance....you see most of them don't have the financial resources to do this business well. As you know it is an expensive business....that is why you see the Indians doing this business".*

All the importers are based in urban communities. Later in Section 6.4 of this chapter, I will show how this affects garment producers in rural communities in Uganda.

6.1.3 Air transport

Air transports of garment making machinery takes an average of one week to arrive at the Entebbe International Airport from either an AD or Western economy. The traders usually require an additional week for documentation and clearing before transporting the goods to their final destination in Uganda. It is the fastest means of transporting the machines into Uganda. However, air imports are relatively expensive (GoU, 2012). However, this mode of transport becomes very pertinent when there are pressing demands for garment making machines. The CEO of LIDA, an Indian owned garment making equipment importer provides an instance where the firm had to import by air

> *"during the campaign for the 2011 election.......I imported a lot of sewing machines for members of the NRM* [National Resistance Movement]...... *you know they were distributing them in the villages for votes...they sometimes tell me to deliver them within a week.....so I imported them by plane* [air]*".*

6.2 Government technical and vocational institutions

The Government of Uganda recognises that a lack of basic technical and vocational skills is one crucial issue hampering the productivity of Small and Medium Scale Enterprises in the country (BTVET-Uganda, 2003). In response, the government has established various technical and vocational institutions across the country. However, due to lack of funding from the government, only a few such institutions are currently in operation. The location of 80 % of the institutions currently in operation is in the cities (BTVET-Uganda, 2003). These institutions place more emphasis on quality than the quantity of the garment making machines they have. The idea is that they may not have enough funding from the government to acquire machines every year for distribution. This makes them concentrate on purchasing Western made sewing machines since they are more durable and can be used for a longer period. The Textiles Development Agency (TEXDA) is among the few organisations that provides training in garment manufacturing in Uganda. However, due to inadequate funding, they resort to the use of Western made garment making machines. A manager at the TEXDA explains that

> *"we don't get enough funding from the government these days......so we keep the machines so that new student who will be admitted can use them.....this machine* [WSM] *can work for a long time without breaking down.....it only need proper cleaning and oiling....as for the Chinese machines, they breakdown frequently and when they breakdown, we cannot buy new ones since we don't have one".*

Therefore, the institutions do not allow the students to take the machines away after training. This implies that after graduation students will have to acquire their own machines to start up a tailoring business. Despite the fact they are unable to take away the garment making machines after the training programme, they end up acquiring the skills in operating and repairing the garment making machines in the country. The issue of skills transfer will be discussed later in Chapter 7 and 8.

6.3 Mechanism of transfer of large scale technologies into Uganda

The previous sections of this chapter analysed the mechanism of transfer of garment making machines at the small scale level. I now focus on the mechanism of transfer of garment making technologies at the large scale level. There are two main mechanisms of transfer of industrial garment technologies from the AD and Western economies into Uganda—Foreign Direct Investment (FDI) and cross-border movement of personnel. This section discusses each of these to show the differences in the transfer mechanisms into Uganda.

6.3.1 Foreign direct investment

Table 6.2 presents a list of large scale firms in Uganda. There are currently 24 AD owned, four Western owned and six locally owned large scale garment making firms that are registered with the Uganda Investment Authority (UIA) (Table 6.2). Almost all the AD firms obtained their license to operate after 2009, but three out of the four

Western firms have been operating for more than 10 years (Table 6.2). The last Western firm to receive its operating license from the UIA did so in 2001. Those of the AD firms are relatively recent. Before the year 2000, there was only one licensed AD garment manufacturing firm in Uganda (Table 6.2). However, over the last seven years, the number of investments from AD companies into the garment sector has far outstripped the number of Western and local firms (Table 6.2). This is an example of Kaplinsky and Messner (2008)'s explanation that FDI has become one of the channels of interaction between the Asian Drivers and other developing countries like Uganda. The rapid increase in the number of AD firms in the garment sector also validates the growing significance of AD economies in general economic growth in developing countries. As indicated above, this study has also contributed to literature by showing that FDIs from the AD economies to developing countries like Uganda also focus on the manufacturing sector and not only in primary commodities and infrastructure (Farooki and Kaplinsky, 2012, Dent 2011 and Brautigam 2009).

Local investment in large scale garment production has not been encouraging over the years. As indicated by Obwona *et al.* (2013) the high cost of capital, lack of technological capacity and technical skills, as well as the huge presence of cheap imported garment products are among the issues discouraging local garment production in Uganda. This is coupled with lack of government support for the industry. Table 6.2 shows that there are only six local large scale garment making firms in Uganda. As indicated in Chapter 3, I purposively sampled 11 of the large scale garment manufacturing firms listed in Table 6.2. These firms include four AD firms, two Western firms, and five local firms as outlined in Table 6.2. None of those interviewed and classified as AD firm were owned by Ugandan-Asians. Relative to the investments made by the Western and local Ugandan firms, FDI from the AD economies has led to the creation of more jobs per establishment (Table 6.3). Table 6.3 below shows that on average, an AD garment production firm employs 134 employees for various garment production operations. The Western and local firms on the other hand employ an average of 71 and 104 workers respectively (Table 6.3).

Table 6.2: List of large scale garment producers in Uganda by their source and planned employment

	Company	Planned Employment	Ownership	Country	License Date
1	Shariatpur Garments Investments (U) Limited	86	Foreign	Bangladesh	14/10/2010
2	Lion - King (U) Limited	50	Foreign	China	29/09/2009
3	Golden Lake Limited	225	Foreign	China	14/01/2010
4	Asian Victor Textile Printing And Dying Company Limited	145	Foreign	China	08/02/2010
5	Sambo Textile & Garments Co. (U) Limited	130	Foreign	China	10/02/2010
6	Bamu Textiles Limited	110	Foreign	China	19/02/2008
7	Golden River Textile (E.A) Company Limited.	150	Foreign	China	06/04/2008
8	Uganda Rosely Home Textile Manufacturing Ltd	50	Foreign	China	30/08/2007
9	Lily Benefit Investments Limited	110	Foreign	China	07/12/2007
10	Happiness Investment Ltd	51	Foreign	China	27/04/2012
11	New Mukisa Shop Limited	143	Foreign	China	26/07/2012
12	Starry Investment Company (U) Limited	115	Foreign	China	29/08/2012
13	Delicacy Uganda Limited	180	Foreign	China	03/10/2012
14	Xiang Long International Trade (U) Ltd	80	Foreign	China	08/10/2012
15	L.G Investments Limited	230	Foreign	China	10/10/2012
16	The Cotton Products Of Uganda Limited	83	Foreign	India	7/10/2009
17	Ajay Cotton Limited	124	Foreign	India	05/11/2009
18	Ridhi Enterprises (U) Limited	65	Foreign	India	26/10/2010
19	Tirumala Enterprises Limited	52	Foreign	India	16/04/2012
20	Dabani Limited	352	Foreign	India	24/10/2012
21	Sigma Knitting Company Limited	120	Foreign	India	15/04/1996
22	Asiatic Sports Limited	117	Foreign	India	15/08/2012
23	Accano Ltd	52	Foreign	Pakistan	17/03/2009
24	Southern Range Nyanza Limited	400	Foreign	Hong Kong	22/06/1973
25	Phenix Logistics	80	Foreign	Japan	12/09/1971
26	Ellim Investments Company Limited	100	Foreign	Japan	23/04/2000
27	AGM International	13	Foreign	United Kingdom	08/04/1996
28	Fusion Africa Ltd	90	Foreign	Germany	23/07/2001
29	Viva Holdings Ltd	21	Local	Uganda	05/12/2011
30	21st Century Manufacturers (U) Ltd	51	Local	Uganda	19/02/2004
31	Acha Graphics Ltd/ Chui Arts	37	Local	Uganda	14/03/2005
32	Faith Fashion Solution Enterprise	50	Local	Uganda	05/01/2010
33	Kwera Limited	180	Local	Uganda	26/07/1991
34	Christex Garment Industry	250	Local	Uganda	1/09/1990
35	Sempa Nansamba Limited	57	Local	Uganda	21/07/2011

Source: A compilation of Uganda Investment Authority, Accessed in September, 2012

Table 6.3: Average number of jobs created by the large scale firms by origin

Company	Country	Location of Interview	License Date	Ave. No. Employed
AD firms				
Sigma Knitting Company Limited	India	Jinja	15/04/1996	120
Asiatic Sports Limited	India	Kampala	15/08/2012	118
Southern Range Nyanza Limited	China	Jinja	22/06/1973	174
Ajay Cotton Limited	India	Kampala	05/11/2009	124
			Average	**134**
Western Firms				
Phenix Logistics	Japan	Kampala	12/09/1971	80
Fusion Africa Ltd	Germany	Kampala	23/07/2001	62
			Average	**71**
Ugandan Firms				
21st Century Manufacturers (U) Ltd	Uganda	Kampala	19/02/2004	100
Acha Graphics Ltd/ Chui Arts	Uganda	Kampala	14/03/2005	92
Faith Fashion Solution Enterprise	Uganda	Kampala	05/01/2010	74
Kwera Limited	Uganda	Kampala	26/07/1991	134
Christex Garment Industry	Uganda	Kampala	01/09/1990	120
			Average	**104**

Source: Based on data obtained from the Uganda Investment Authority, Accessed in September, 2012

Table 6.4 shows the labour turnover rate in the garment firms by their country of origin. Labour turnover is the ratio of the average number of employee departures to the average number of employees available in the firm per production year (Rubery *et al.* 2011). Despite the fact that the AD firms employ more labour than the Western firms on average, the average labour turnover rate for the former is higher than that of the latter. The AD firms recorded an average turnover rate of 35 % whereas that of the Western firms was 13 % (Table 6.4). The high labour turnover in the AD firms is due to poor remuneration. A knitting machine operator in one of the AD firms indicates that

> *"I was among those who were employed in this company first.......... but after 4 years, almost all my colleagues are gone....... because the money is not well [enough]".*

My field interviews show that the Western firms remunerate their workers better. Interviews with the machine operators shows that an AD firm pays a monthly average rate of US$ 80 compared to US$ 170 for a Western firm.

Table 6.4: Employment and labour turnover rate in the large scale garment firms

	Ave No. of Employees /production year	Ave. No. of employee departures/production year	Ave. Annual Turnover Rate (%)
Local Firms	134	28	21
AD Firms	92	32	35
Western Firms	71	9	13

Source: Author's Field Data 2012-2013

The high labour turnover rate in the AD firms has however created an indirect benefit. It has resulted in the transfer of soft technologies in the form of skills and technological competence into the garment sector. The AD firms often have the skill to interact effectively with the Ugandan employees; this makes it easier for them to train the local employees on how to use the different garment making machines (see Case study 2 below).

The high labour turnover rate makes the local employees move to other firms for higher wages or establish their own firm taking the skills they have learnt with them. The production manager at Christex a local garment firm in Uganda states that

> *"I have been working in the garment industry for more than 5 years now.....I started from Asiatic Sports.....it* [i.e. Asiatic sports] *is an Indian firms [AD firm] but they were not paying me well so I left to this place"*

Another self-employed garment producer in Kampala also indicates that

> *"I was working at Sigma Knitting* [i.e. an AD firm]......*but the money was not good....so I left.....I am now on my own".*

In addition, the local operators learn other managerial, supervisory and technical skills from the AD personnel. This makes them more competent to work in the absence of the

ADs and also to set up their own garment firm. Case study 2 is a story on how Sigma Knitting Ltd, an Indian owned garment making firm, transferred soft technology to local garment workers in Uganda.

Case Study 2: Transfer of technological and managerial know-how at Sigma Knitting

Sigma Knitting is an AD owned firm that was established in 1996, with a current total work force of 120. Out of this 80 of the garment workers are casual workers. With the exception of the 5 AD garment engineers (including the Chief Executive Officer), all the workers are Ugandan employees. The firm specialises in knitting and embroidery activities. The firm has a policy which allows casual workers to be promoted to a permanent worker status after 3 years of diligent work. They do this by providing training on how to operate the machines efficiently. In addition, they allocate various supervisory roles to the permanent workers and this makes them acquire additional work experience. Through this, the employees develop managerial and supervisory skills which allow them to work efficiently and professionally on their own even when the AD engineers are absent. The training further generates reverse engineering where the AD engineers help the local operators to be able to maintain and fabricate some parts of the technologies when they breakdown. However, between 2005 and 2010 the firm lost more than 60 workers (including managers) to its competitors—NYTIL and Phenix logistics. Some of them also exited the company to form their own small scale firm. This was attributed to the low remuneration coupled with the fact that the workers work for an average of 14 hours a day instead of the normal 8 hours a day. According to the CEO of Sigma, at least 7 of these employees have been able to establish their own firms which even compete with Sigma for projects at both the national and international level.

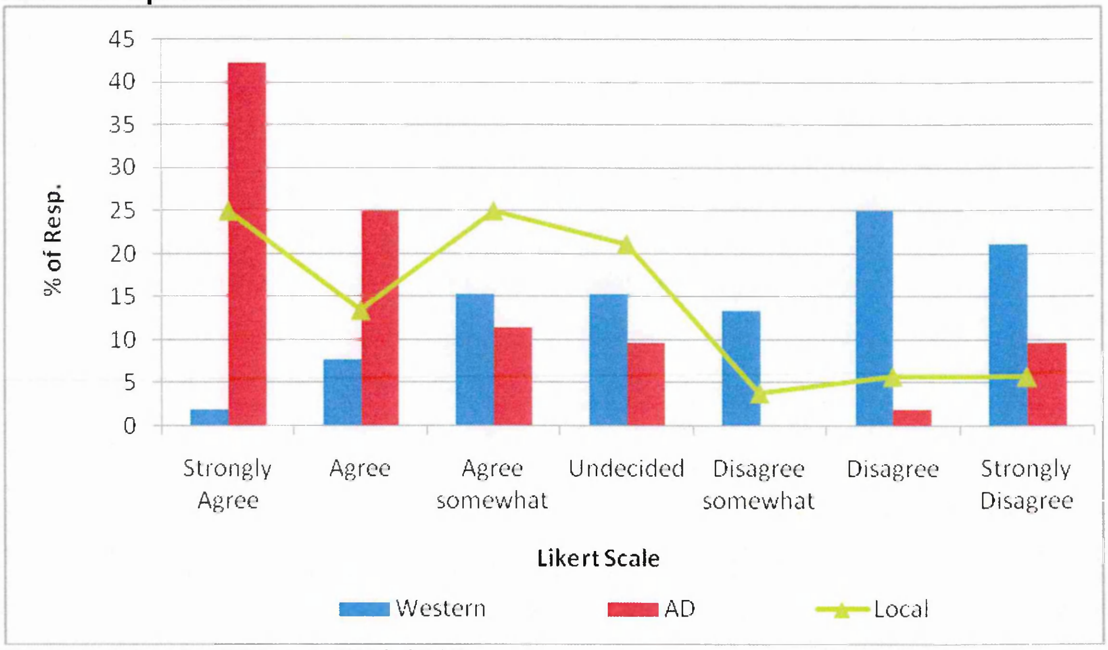
Source: Author's interview with the Chief Executive Officer of Sigma Knitting, 2012

There is often a communication barrier between the Western expatriates and the local operators who speak very little/no English. This inhibits the process of technological and knowledge spillovers due to poor flow of information to the local operators. An embroidery operator at Phenix logistics indicates that

> *"...main problem here is communication....we don't understand them* [Western expatriates] *when they are talking.....I make a lot of mistakes because I sometimes don't get the instructions from them* [Western expatriates] *well".*

Figure 6.1 presents the results of machine operators' likert-scale score on the extent to which the machine operators get information from their superior with regards the machine(s) they work with. The likert scale was based on the following question: *on a scale of 1 (strongly agree) to 7 (strongly disagree), to what extent do you get* *information on the garment making machines from your superiors?* The respondents were made to rank from one to seven where 1 begins with the positive response “strongly agree” to the extreme negative response seven “strongly disagree”. The machine operators agree that information flow from the AD firms is better than the Western firms. Figure 6.1 below shows that 42 % of the machine operators in the AD firms strongly agree that there is enough information flow with regards to the technology they operate. However, only 2 % of the operators in the Western firm strongly agree to this. Conversely, 21 % and 2 % of the operators in the Western and AD firms respectively disagree strongly that there is information flow from the their managers to them (Figure 6.1).

Figure 6.1: Extent to which information on garment making machines flow to machine operators



Source: Author’s Fieldwork, 2012-2013

Without exception, Western firms invest in technologies from the west. They explain that relative to the AD technologies, the industrial Western technologies are more robust and can be used for a longer period without damage. The Chief Executive Officer of Phenix Logistics, a Japanese garment and textiles making firm in Kampala, indicates that

> *"I like the Japanese machines because they will not fail the company and they give* [produce] *more quality garments…they are strong and work faster….I want to do serious business that is why I prefer Japanese machines".*

The foreign investors—AD and Western firms—in return benefit from Uganda's favourable industrial policy which allows a 10 year cooperate tax holiday, exemption of interest on withholding tax on external loans and dividends repatriated, as well as double taxation relief (Okuku, 2006 and UNIDO, 2007 see Chapter 3 above for a detailed discussion). Mutambi (2008) explains that Uganda is deficient in indigenous capacity for the absorption and development of advanced technologies. In view of this, using technologies from the west to create jobs and technological and knowledge spillovers can sometimes be challenging considering that some of the Western technologies are sophisticated and more capital intensive. However, the AD firms use their engineering and managerial competence to identify less sophisticated technologies for their operations. A garment engineer at Asiatic Sports Limited, an Indian sportswear firm indicates that

> *"we have engineers who look for machines that can easily be operated in this country……. the advanced machines are very good but the frequent power fluctuations will destroy it….our workers are not used to the advanced technologies"* .

6.3.2 Cross-border movement of personnel

According to Maskus (2004), transfer of technologies cannot be successful and affordable without the complementary services and know-how of professionals such as managers, engineers and technicians. This is to ensure effective utilisation of the technology but often results in a spillover of technological know-how to potential operators and local firms (Maskus, 2004). The number of machine experts from the AD economies to the garment sector is higher than those from the Western economies. The rates quoted by the AD experts are lower and more affordable; as such local firms are also able to access them. Table 6.5 outlines the details of expatriate staffing levels by firm type. Specifically, out of an average of 30 highly skilled workers in each of the four AD firms that were sampled, 12 of them representing 40 % are from the AD economies. On the other hand, an average of two out of nine skilled workers (representing 22.22 %) in each of the Western firms that were sampled are expatriates from the west. None of the local firms included in this study employed any expatriate staff.

Table 6.5: Average number of skilled staff in the garment firms

	AD Firms	Western Firms	Local Firms
Locals	18	7	15
	(60.00)	(77.78)	(100.00)
Expatriates	12	2	0
	(40.00)	(22.22)	(0.00)
Total	**30**	**9**	**15**

Source: Author's field data, 2012-2013 NB: Figure in parenthesis are in percentage

Cross border movement of personnel also encourages reverse engineering. Reverse engineering is the process of understanding the principles of a technology by analysing its structure, function and operation in order to be able to maintain it or create a new one without duplicating the original (Dehaghi and Goodarzi, 2011). For reverse engineering to be successful, there must be an efficient flow of information to the technology recipient (Hoekman *et al.* 2004). This leads to the acquisition of tacit knowledge and skills which is acquired over a period of time (David and Foray, 2001). The data I collected shows—as outlined in Section 6.3.1—that the training offered by the AD firms helps the local operators to maintain and fabricate some parts of the technologies when they breakdown.

The Western firms generally utilise expatriates from the Western economies to repair their technologies. Thus as explained by Markusen (1995) in the short run they are able to increase output mainly because the expatriate workers are available to keep the technologies working efficiently. However, interviews with managers of the large scale firms show that output can decline or stagnate when the machine breaks after the departure of the expatriate workers. The CEO of Sigma Knitting also explained that

"….when the German machines breakdown…we call the manufacturers to come and repair it [them]*…..we can't repair it because we don't have the expertise…..so they send their people for the repair works…..yes that means we have to wait for them to come and repair it. I remember, there was a time that two of my printing machines was damaged because of the power fluctuation….I waited 3 weeks……during that time I was just turning down contracts….it was a big loss."*

This also leads to little/no local capacity building with regards to the machines. The local firms on the other hand rely on the AD experts for installation of their newly acquired technologies. These AD experts are employed on a temporary basis for these machine installations. An engineer at Christex Garment Industry, a local large scale garment manufacturing firm explains that

"we import our machines from China....but in terms of installation, we give the contract to the Indians to do it for us. It is cheaper than the people from Europe….the challenge is that some of the German machines are difficult to repair….so when they breakdown in the absence of the Indians we abandon it….but it is very efficient when it is in use"

Thus, the high labour turnover rate from the AD firms, coupled with the easier access to AD expatriates (relative to experts from the west) serves as a means of soft technology transfer to the local garment producers in Uganda. This study has enriched the technology transfer literature by showing that not only do the AD firms and expatriate personnel play a role in the transfer of hard technology but they are also important in the transfer of the soft component of technology.

6.4 The distribution of AD and Western garment making machines

Having identified the various modes of transfer of the garment making machines into Uganda, it is necessary to examine which of them—AD or Western made garment making machines—are more widely diffused in Uganda. As discussed in Section 5.1, production of garments at the small scale level is done in urban and rural communities. Therefore I focus the discussion on garment production in rural and urban areas. I further analyse the extent of the distribution of garment making machines from four different perspectives:

1. The rate of adoption of the garment making technologies
2. The distribution of the garment making technologies by location of the firms
3. Access to the garment making technologies and its parts by location after purchase from an urban based importer.
4. Effect on income distribution

Analysing the diffusion from these four perspectives will fill gaps that were identified in the diffusion literature in Section 2.2.2 above. This pertains to the fact that available studies have paid limited attention to information and finance as means of diffusing technologies to the manufacturing sector in a developing country like Uganda.

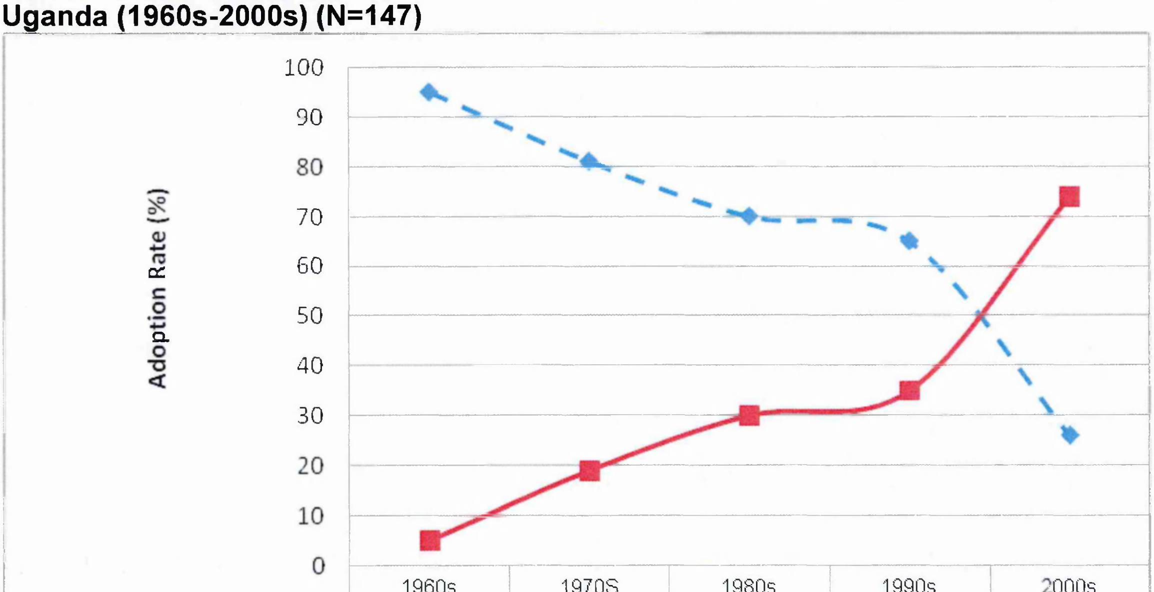
6.4.1 The rate of adoption of garment making technologies

The field data I collected shows that more garment producers are adopting the AD garment making machines relative to the Western ones. This was not the situation two to three decades ago when Western technologies were the main technologies in the sector. This may be due to the total trade liberalisation policy that the Ugandan government introduced in the early 1990s. The manager of the Textile Development Agency (TEXDA) explains that

> *"sewing machines, knitting machine and all those machines were coming from Europe......it was until the early 2000s when this government introduced the total liberalisation policy that we started seeing a lot of Chinese machines* [AD technologies] *into the country......otherwise we were used to machines from Europe".*

Figure 6.2 below presents the rate of adoption of garment making machines in Uganda from the 1960s to the 2000s, by identifying the percentage of firms that acquired garment making machines within the periods in question in Uganda. This was done by ascertaining from the 147 respondents, when they acquired their machines. The study shows that 95 % of the garment producers who acquired garment making technologies in the 1960s acquired the Western type. However, the adoption rate for the Western made garment making machines declined to 81 % in the 1970s, with the balance supplied from the AD economies. By the 2000s, the percentages of AD garment making technologies far outweighed those from the Western sources. 74 % of respondents acquired AD garment making technologies in the 2000s relative to 26 % for the Western ones (Figure 6.2).

Figure 6.2: Rate of adoption of AD and Western garment making technologies in Uganda (1960s-2000s) (N=147)



	1960s	1970S	1980s	1990s	2000s
Western machines	95	81	70	65	26
AD machines	5	19	30	35	74

Source: Author's field Data, 2012-2013

This may be attributed to the fact that there was imperfect information on the AD garment making technologies before the 2000s and this led to a low demand for the AD garment making technologies. A leading Ugandan sewing machines importer indicates

> *"I realised earlier that this business is lucrative, but I was not motivated because Ugandans were not having confidence in the Chinese machines due to lack of sufficient information on the machines......people were interested in the Japanese and the European machines, but I did not have the money to import them* [i.e. Western technologies]*...I was encouraged to start this business in*

2000 when I visited a friend's shop in South Africa and saw the high demand for the Chinese sewing machines......few years later I started the business, and it was admirable because profit was high".

My interviews also show that easier access to internet services particularly after the year 2000 in Uganda has contributed in reducing the level of uncertainty associated with the AD garment making machines. Machine operators read about the properties of the AD machines on the internet and also view various components of the machine in the internet. The chairman of the Kiyembe tailors association indicates that

"our member rely on the internet to get information about the machines....as for the British ones we are familiar with them...but when Sevo [Museveni] *came he brought the internet in 2001. So we check the properties of the China machines on the internet before we buy them"*

Furthermore the growing AD-Uganda trade relations in garment making machines after 2000s (see Chapter 3) may also be the reason why information on AD garment making technologies has become easier to access in the country. This enriches literature with evidence from the Ugandan manufacturing sector that information is important for the diffusion of technologies in developing countries. This is because consumers like to have adequate information about the technology before adopting it (See Rogers, 2003 and Narayanan, 2013). On the supply side, financial institutions in Uganda facilitate the importation of capital equipment by providing various credit facilities to traders who import from China. The financial institutions recognise the growing demand for AD technologies by low income consumers and producers in Uganda (See Case Study 3 below). This is as a result of the higher loan recovery rate that the banks record in dealing with traders who import the machine from China. This and Case Study 3 confirm the fact that finance cannot be ignored when it comes to the distribution of technologies in a developing country like Uganda. Case Study 3 describes how The Crane Bank, Uganda became motivated in the provision of financial support to traders who import capital equipment from the AD economies.

Case Study 3: Crane Bank's Growing interest in AD garment machines

Established in 1995, Crane Bank is today the largest locally owned Commercial Bank in Uganda. The bank is a part of the Ruparelia Group of Companies whose business interest inter alia includes Commerce, Insurance, Hospitality, Property Ownership and Management. During the late 1990s and early 2000s, importers of home appliances such as domestic sewing machines from the Western economies—Germany, Japan, United Kingdom and United States of America formed a key component of the bank's customer base. Though consumers were willing to acquire the imported home appliances from the Western countries, the high cost of the appliance was a disincentive for the majority of Ugandans when deciding which appliance to buy. This led to a decline in the demand for the appliances from the west; which also meant that it took a longer time for the traders to sell their goods. This affected the relationship between the Bank and the importers in the sense that loan recovery rates from the importers became a major challenge for the Bank. Consequently, the bank started losing interest in financing importers. For instance, the bank decided in 1990 to give not more than $ 5000 to the importers. This package became very unattractive to the importers since $ 5000 was not enough to fund the transport cost and at the same time buy the machines in wholesale quantities. This was also the time when the bank had increased its interest rate from 24-25 % to 30-32 %. As a result, most of the importers abandoned their import businesses. However, in the mid-2000s, the Bank introduced a product where it imports home appliances from China, Hong Kong and Dubai (a major transit point for Chinese goods) and sells them on hire purchase to its customers who are salaried workers. Upon realising the lucrative and profitable nature of the business, the Bank started providing more loans to traders who were prepared to import from the AD economies. The Bank at that time was sure of a higher loan recovery because it understood the nature of the market. Currently, the Bank has reduced its interest rates to 25 % for importers who import from the ADs and they have become very important customers to the bank.

Source: Author's interview with a Credit officer at The Crane Bane, 2012, and http://www.cranebanklimited.com/; accessed on 01/11/2012

6.4.2 Beyond the aggregates: patterns of distribution of AD and Western machines

Having understood the general trends with regards to the adoption of garment making machines from the two different sources, I now explore the differences in penetration of garment making technologies by the location, gender and education of the firm owner. These three indicators were considered because they are central to issues pertaining to poverty reduction in Uganda.

I. Distribution of Garment making machines by the time of establishment of the firm

The study has shown in the Section 6.4.1 that the period of establishment of adoption of the garment making machine is important for its diffusion. The study now presents some specifics on some of the garment making machines that were acquired before and after 2000. This is based on interviews I conducted with the 147 small scale garment producing firms in Uganda. From 2000 and beyond, 58 firms that use manual sewing machines were using AD treadle machines (Table 6.6). 13 of them also use Western made treadle sewing machine (Table 6.6). A reverse is true when it comes to firms that were established before the 2000s. The similar situation was recorded for the cutting machines. In the case of the pressing machines, all the garment firms use AD machines (Table 6.6). Table 6.7 is a Pearson's Correlation table which shows a significant negative correlation between the period of establishment of the firms and the use of WSMs. On the other hand, the results show a significant positive correlation between the period of establishment of the firm and the number of users of ADSM (Table 6.7). This evidences the observation in the earlier discussion (Section 6.4.1) that whereas the number of garment producers who are adopting ADSMs is increasing, WSM adopters are declining as the years pass by.

Table 6.6: Average distribution of the machines by period of firm establishment

Category of Technology	Type of Machine	Before 2000	2000 and beyond	Total
Sewing machines				
Hand Operated Machine	ADSM	0	6	6
	WSM	1	1	2
Manual Treadle Machine	ADSM	3	58	61
	WSM	9	13	22
Electric Treadle Machine	ADSM	9	22	31
	WSM	15	10	25
Total		**37**	**110**	**147**
Cutting Machines/Devices				
Manually Operated	AD Made	11	63	74
	Western Made	37	30	67
Electric Cutting Machines	AD Made	0	0	0
	Western Made	0	6	6
Total		**48**	**99**	**147**
Pressing Machines				
Coal Fired Pressers	AD made	5	72	77
	Western Made	0	0	0
Electric Pressers	AD made	0	65	65
	Western Made	0	5	5
Total		**5**	**142**	**147**

Sources: Author's field work, 2012-2013

Table 6.7: Correlation between firm establishment and sewing machine users

Correlations				
		Period of Firm Est	Users Of AD machines	Users of Western machine
Period of Firm Est	Pearson Correlation	1	0.336***	-0.312***
	Sig. (2-tailed)		0.000	0.000
	N	144	144	144
Users of AD Machines	Pearson Correlation	0.336***	1	-0.916***
	Sig. (2-tailed)	0.000		0.000
	N	144	148	148
Users of Western machine	Pearson Correlation	-0.312***	-0.916***	1
	Sig. (2-tailed)	0.000	0.000	
	N	144	148	148

*Source: Computation based on author's fieldwork, 2012-2013 *** Correlation coefficient is significant at the 0.01 level (2-tailed).*

II. Distribution of garment making technologies by location and sources

The study estimates the location of the machine by identifying the location of the garment making technology that is being used by the producers for production. Table 6.8 shows that the AD technologies are more widely spread than the Western ones in both urban and rural communities. For instance, manually operated ADSM treadle sewing machines are more widely distributed in rural communities (52 machines) than the WSMs (19 machines) (Table 6.8). Lack of capital and energy infrastructure in the rural communities is the main factor that is limiting garment producers from acquiring WSMs. The situation is not different for cutting and pressing machines (Table 6.8). All the pressing machines in the rural communities were coal fired (Table 6.8). The cutting devices were also manually operated. A garment producer in Kiyonga a village close to Iganga in the Eastern region of Uganda explains that

> *"there is no electricity in this village.......so I buy a machine that can work without electricity.....otherwise it will be useless......if the government brings electricity I will buy a machine that can use power".*

Table 6.8: Respondents with garment making technologies by location and source

Category of Technology	Type of Machine	Rural	Urban	Total
Sewing machines				
Hand Operated Machine	ADSM	4	1	5
	WSM	3	0	3
Manual Treadle Machine	ADSM	52	5	57
	WSM	19	7	26
Electric Treadle Machine	ADSM	0	31	31
	WSM	0	25	25
Total		**78**	**69**	**147**
Cutting Machines/Devices				
Manually Operated	AD Made	78	61	139
	Western Made	2	0	2
Electric Cutting Machines	AD Made	0	0	0
	Western Made	0	6	6
Total		**80**	**67**	**147**
Pressing Machines				
Coal Fired Pressers	AD made	77	0	77
	Western Made	0	0	0
Electric Pressers	AD made	0	65	65
	Western Made	0	5	5
Total		**77**	**70**	**147**

Sources: Author's field work, 2012-2013

Later in Chapters 7,8 and 9, the study will show that relative to the ADSMs, the WSMs are not able to operate efficiently in locations where there are no energy infrastructure—particularly the rural communities. The total number of operators who use only manually operated AD cutting machines in both urban and rural communities is 139 (Table 6.8). However, only two of them use manually operated Western made cutting machines. The study identified only six machine operators who use Western made manual cutting machines (Table 6.8).

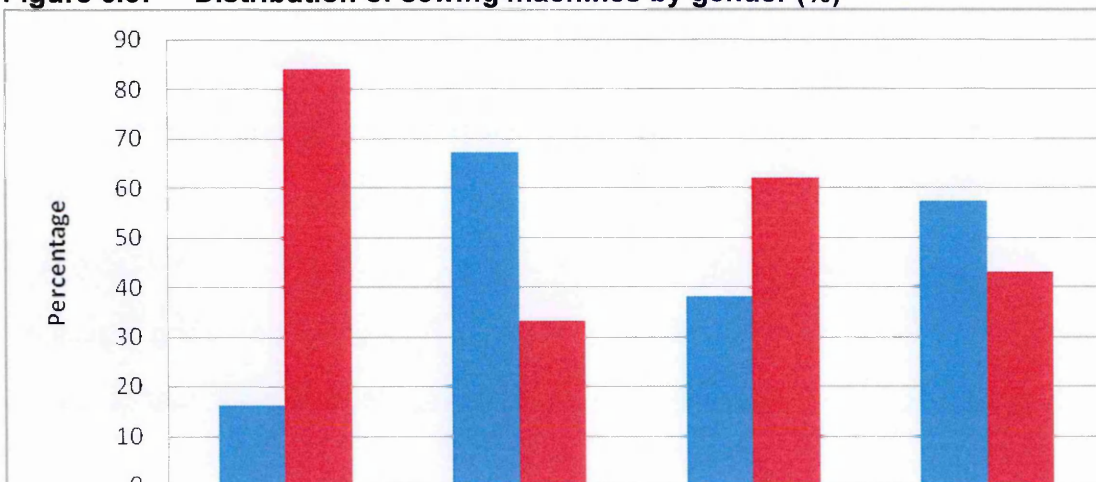
III. The relationship between distribution of sewing machines and gender

UNIDO (2007) states that

> *"Women are.....engaged in.....garment production but the technologies used in production of.....garments do not take into account the gender dimension and women find them difficult to work with."*

This assertion by UNIDO may be consistent with the Western technologies because of their complicated nature. However, technologies from AD economies perhaps provide a different picture of the situation. Figure 6.3 shows that distribution of Western garment making machines is wider among male garment producers than female producers. In addition to the fact that AD garment machines are more distributed among female producers than male producers; their distribution is also wider in rural areas than urban areas in Uganda (Figure 6.3). The AD garment making machines are cheaper and more affordable for low income consumers; therefore, considering the fact that income levels of males are higher than that of females (see Chapter 4 above), more female garment producers may go for AD garment making machines relative to men. This is partly because income levels for female garment producers in rural communities are very low and as such they prefer the use of less capital intensive machines like the ADSMs. A female garment producer in the rural communities explains that *"I don't like this China machine* [ADSM] *but they are also very cheap".*

Figure 6.3: Distribution of sewing machines by gender (%)



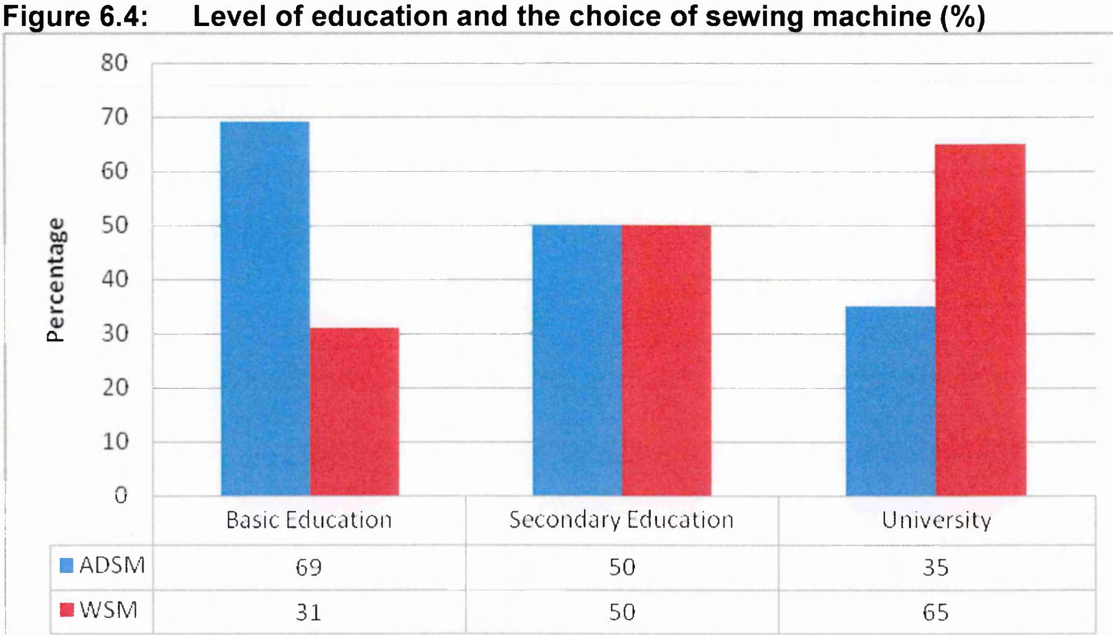
	Rural ADSM	Rural WSM	Urban ADSM	Urban WSM
Male	16	67	38	57
Female	84	33	62	43

Source: Author's Fieldwork, 2012-2013

IV Level of education versus distribution of garment making machines

Level of education of garment producers is another important factor for assessing the extent of penetration of garment making machines in Uganda. All the respondents that were sampled for the study have some form of education. Available literature shows that education has a positive correlation with earnings (Bloom *et al.* 2006). Figure 6.4 below shows that a producer with higher levels of education is more able to acquire relatively capital intensive technologies. 69 % of the garment producers who have only basic education use ADSMs (Figure 6.4). Conversely 31 % of the garment producers with basic education use WSMs whereas 65 % of those with university education use WSMs (Figure 6.4). This latter group may have chosen to purchase WSMs because they have been able to acquire both the codified and tacit knowledge on these garment making machines and therefore understand that the capital intensive Western made machines produce stronger stitches and therefore potentially a higher quality final product.

Figure 6.4: Level of education and the choice of sewing machine (%)



Source: Author's Fieldwork, 2012-2013

6.5 Access to the garment making machines and parts by location

Uganda is a landlocked country with poor road infrastructure and high cost of transport (Rudaheranwa, 2009). Therefore it will be more expensive to travel farther distances in purchasing garment making technologies (Rudaheranwa, 2009). The study estimates the distance travelled by a garment producer to access a sewing machine by calculating the distance from the location of the firm to where the producer bought the machine. This computation was based on the 147 small scale garment producers. Traders/importers of the garment making machines are located in urban communities. This is due to the high cost of transporting the garment making machines to the rural areas. A garment making machines trader/importer in Kiyembe-Kampala, indicates that

> *".....yes I was having some branches in Mbale.....but the you see the roads are very bad...so the drivers charge so much for transporting the machines......you can pay more than UGX 10 million for transport from Kampala to the rural areas.... I can't go there with my machines......so they travel to my store here in Kampala to buy the machines"*

The owner of Senga sewing machines also indicated that

> *"I know there are more customers in the rural areas.....but you see, I will make a lot of losses if I transport all these machines to the rural areas....the roads are bad and transport cost is very high.....dust is all over the place* [rural areas]*.....if you don't take care all the machines will get damaged by dust before you sell them"*

The field data shows that a garment producer living in a rural environment travels an average of 14.44 kilometres to be able to access AD technologies to buy. The producer will have to travel farther (i.e. 113 kilometres) in the case of a Western machines (Table 6.9).

Table 6.9: Distance required to access garment making technologies and spare parts (Kilometres) (N=147)

	Ave. Dist travelled to nearest distribution* centre for ADSMs (Kilometres)	Ave. Dist travelled to nearest distribution centre for WSMs (Kilometres)
Access to Garment making Technologies		
Rural producer	14.44	112.70
Urban producer	8.82	22.44
Access to Spare parts for Garment making Technologies		
Rural producer	7.53	131.67
Urban/Cities producer	2.88	17.64

*Source: Field Data, 2012-2013 *distribution centre describes the point of sale of the machine*

The distance required to access AD garment making machines is shorter in the urban communities. Garment producers located in urban communities only travel 8.8 kilometres to be able to access AD machines. In the same vein, a firm will travel 22.44 kilometres to purchase Western machines in the urban areas (Table 6.9). Relative to the Western garment machines, the wider distribution of the AD garment making machines makes garment producers travel relatively a shorter distance to acquire them. This positive relationship is evidenced by the Pearson's correlation coefficient of 0.460 at 0.01 significant levels (Table 6.10). On the other hand, more producers travel a shorter distance to access AD technologies; this negative relationship is reflected in the Pearson correlation coefficient of -0.507, 0.01 significant level (Table 6.10).

Access to spare parts is important for the efficient maintenance of the garment making machine. In general, AD machine parts are more accessible than the Western ones. The data shows that whereas a garment producer or a repairer in rural communities will travel an average of 7.5 kilometres to be able to purchase a spare part of an AD technology, the entrepreneur will have to travel an average of 132 kilometres for Western machine parts (Table 6.9). This is because most of the spare parts of the Western garment technologies are sold in the cities. However in the cities, it is easy to access sewing machine parts for both Asian Drivers and Western machines. This is shown with a significant negative Pearson correlation coefficient of -0.371 (Table 6.10). On the other hand, the study establishes a significant positive correlation between the number of garment producers and the distance they have to travel in order to access a Western machine spare part (Table 6.10). The general conclusion is that the gap in AD technology access across Uganda is becoming smaller and the spread effects larger than the Western machines.

Table 6.10: Correlation between the number of sewing maching purchasers and distance travelled

Correlations					
		UWT	UADT	DAM	DASP
UWT	Pearson Correl	1	-0.916***	0.460***	0.337***
	Sig. (2-tailed)		0.000	0.000	0.000
	N	148	148	148	146
UADT	Pearson Correl	-0.916***	1	-.507***	-.371***
	Sig. (2-tailed)	0.000		0.000	0.000
	N	148	148	148	146
DAM	Pearson Correl	0.460***	-0.507***	1	.0718***
	Sig. (2-tailed)	0.000	0.000		0.000
	N	148	148	149	147
DASP	Pearson Correl	0.337***	-0.371***	0.718***	1
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	146	146	147	147

*Correlation is significant at the 0.01 level (2-tailed) *** Correlation coefficient is significant at 1 % level NB: UWT—Users of Western technologies; UADT—Users of AD technologies; DAM—Distance required accessing a garment making machine; DASP—Distance required accessing the spare part of a garment making spare part*

6.6 Effects of distribution of garment making machines across quintiles

As indicated in Chapters 1 and 2 above, inequality is one of the growing challenges in Uganda's fast growing population. In this section I analyse the effect of the distribution of the AD and Western garment making machines on inequality in Uganda. This was based on a question I posed to the machine operators to indicate the percentage of their total daily revenue (as a result of using their garment making machine) that they take as their daily income. The daily revenue is the product of the unit price and quantity of garments produced daily. Based on the various percentages they indicated, I computed the daily income for each machine operator. Following UNU-WIDER (2008), World Bank (2011) and Eurostat (2011) I divided the population into quintiles in ascending income level and then determined the proportion of the total income by users of the garment making machines. Quintiles represent five equal-sized groups of the machine operators.

The lowest quintile describes machine operators with incomes in the bottom 20 per cent of the income distribution (World Bank, 2011). The highest quintile on the other hand describes machine operators in the top 20 % of the income distribution (World Bank, 2011). In order to measure the level of income inequality the ratio of the incomes received by the top 20 % and the bottom 40 % of users of the garment making machines were computed (World Bank, 2011). There would be an even distribution of income if the value of the ratio is equivalent to or lower than one. However, inequality would be higher if the value of the ratio is greater than one. Table 6.11 presents the distribution of incomes levels of users of the technologies by quintiles. The ratio between the richest quintile and the bottom 40 % for users of the AD garment making machines is almost 1. This implies there is generally an even distribution of income among users of the AD garment making machines. The richest quintile and bottom 40 % of users of the AD technologies respectively controls 28 % and 27 % of aggregate income levels (Table 6.11).

Table 6.11: Distribution of garment making technologies across income levels of machine operators

Poverty Quintile	Users of AD technologies (%)	Users of Western Technologies (%)
Poorest	11	2
2	16	3
3	18.7	18
4	26.4	32
Richest	28	45
Ratio of top 20% to bottom 40%	1.04	9

Source: Based on author's field data (2012-2013)

However, the richest group for users of Western garment making machines control 45 % of the aggregate income. The poorest 40 % on the other hand controls only 5 % of the aggregate income of the consumers (Table 6.11). Furthermore, the ratio between the income levels of the richest 20 % and the poorest 40 % of users of Western made sewing machines is 9 (Table 6.11). This shows an uneven distribution of income among users of the Western machines. Relative to the Western garment making technologies, the easier access, low cost nature, coupled with the wide spread of the AD technologies has reflected positively on income distribution.

I also considered the distribution of the garment making machines across the quintiles by gender. The wider spread of the AD technologies (see Figure 6.2 above) has impacted positively on income distribution among females relative to males. Inequality among female users of AD technology recorded a very low ratio of 0.87 and that of men was higher at 1.89 (Table 6.12). On the other hand, there is a relatively uneven spread of income among male and female users of Western technologies (Table 6.12).

Table 6.12: Distribution of garment making technologies by income levels and gender of machine operator

Poverty Quintile	*Male*	*Female*
AD Technologies		
Poorest	8	14
2	10	16
3	19	19
4	27	25
Richest	34	26
Ratio of top 20% to bottom 40%	1.89	0.87
Western Technologies		
Poorest	9	10
2	14	16
3	21	19
4	25	21
Richest	31	34
Ratio of top 20% to bottom 40%	1.35	1.30

Source: Based on author's field data (2012-2013)

I also considered the distribution of the garments making machines across income levels of the machine operators in both urban and rural areas. In rural areas, the ratio between the richest quintile and that of the poorest 40 % is almost the same for the two types of garment making machines, despite the fact that the Western technologies are more capital intensive than those of the AD technologies (Table 6.13). In the urban communities, the ratio is lower in favour of the AD technologies (Table 6.13). Later in

Chapters 7 and 8 below I will discuss the capital intensive nature of the Western technologies.

Table 6.13: Distribution of garment making machines by income levels and location of machine operators

Poverty Quintile	AD Technologies	Western Technologies
Rural		
Poorest	12	10
2	14	12
3	19	17
4	26	19
Richest	29	26
Ratio of top 20% to bottom 40%	1.12	1.18
Urban		
Poorest	10	8
2	15	11
3	19	18
4	26	27
Richest	31	36
Ratio of top 20% to bottom 40%	1.24	1.89

Source: Based on author's field data (2012-2013)

6.7 Conclusion

I started this Chapter by analysing the mechanism of transfer and distribution of garment making technologies at the small and large scale level. In general, Uganda's landlocked nature makes the cost of transporting capital equipment into the country expensive and difficult. However, due to the less capital intensive nature and easier access to AD technologies, local importers are able to import them with limited financial resources. I also conclude that at the small scale level, the spread effect of the AD technologies is wider and they are capable of operating more efficiently in locations with no energy infrastructure than Western technologies. Lack of enough information delayed the adoption of the AD garment making technologies until 2000 and beyond when trade between Uganda and the AD economies began to rise. The AD technologies are also easier to access than the Western technologies and this also has implications for poverty reduction. I further conclude that the important role played by the AD economies in the process of transporting the technologies into Uganda cannot be ignored.

At the large scale level I conclude that FDI is one of the key channels through which the AD economies increase their interaction with Uganda and this was demonstrated in the garment sector. There is a growing presence of Asian Driver firms in the manufacturing sector. These AD firms play a complementary role in the transfer of technologies from the Western economies. I further conclude that the AD garment firms play a very important role in the spillover of technological and managerial know-how to the local garment producers. Hence, the distribution of the garment making machines in Uganda is a function of information, finance and the location of the machine.

The role of the AD economies in the transfer and distribution of garment making technologies at the small and large scale levels of garment production cannot be ignored. The Asian Driver expatriate staffs are involved in the transfer of managerial and technological skills to local garment firms in Uganda. The AD expatriate staffs play a very crucial role in training local machine operators on how to operate and manage garment making technologies of both AD and Western origin. Thus there is a knowledge spillover effect to the local garment production market when a machine operator moves from an AD firm to establish his own firm or move to another. Relatedly I also conclude that the AD expatriate staff provide cheaper expertise to the local garment producers than those from Western economies and are more able to fit into the local environment, for example, with reduced language barriers.

CHAPTER 7: COMPARING THE PRIVATE PROFITABILITY OF THE ADSMs AND WSMs AT THE SMALL SCALE LEVEL OF GARMENT PRODUCTION

7.0 Introduction

This chapter compares the private profitability of using AD and Western garment making technologies at the small scale level using data collected for this study. This chapter also considers the sewing machine as a case study for the estimation of private profitability of garment making machines. I consider the sewing machine for two main reasons. First, sewing dominates the output of a garment firm irrespective of the size of the firm. The second reason is due to the limited data available on the other garment making technologies as discussed in Chapter 3.

The chapter is organised into five sections. Section 7.1 describes the coefficients of production of the garment making machines. This is to determine the physical parameters of the AD and Western garment making machines. This is followed by the estimation of cost components involved in the production of garments at the small scale level in Section 7.2. Section 7.3 compares the output of the ADSMs and WSMs. Section 7.4 uses the cost and output figures in Section 7.2 and 7.3 to estimate the private profitability of the two alternative sewing machines as expressed within the parameters of this study.

7.1 Coefficient of production of the ADSMs and WSMs

In determining the physical parameters of the alternative garment making machines, I consider three important variables—these are capital, labour and acquisition cost of capital. How these parameters were measured will be discussed in the next two sections of this chapter. For now, I use the above-mentioned variables to determine the coefficient of production of the ADSMs and WSMs. These are the coefficients of capital, labour, and capital-labour ratio (Morawetz, 1974, Stewart, 1982 and Kaplinsky, 1990). The output-labour ratio (i.e. the productivity of labour, O/L) is represented in this study as a ratio of the annual number of physical units of homogeneous garment (i.e. in terms of a medium sized "kitenge shirt") to the number of labour employed annually (Morawetz, 1974, Stewart, 1982 and Kaplinsky, 1990). The productivity of capital (O/K) is measured by relating the output per year (i.e. in terms of numbers of medium sized "kitenge shirt" produced by the firms studied) to the annual investment cost (US$) of the sewing machine by the same firms (Morawetz, 1974, Stewart, 1982, and Kaplinsky, 1990).

The study also measures the capital-labour ratio (K/L) by computing the ratio of the annual cost of the sewing machine used by the firms studied to the total annual man days used in operating a sewing machine in the firms studied. As indicated in Chapters 5 and 6 above, small scale garment producers mainly use electric AD and Western machines for garment production in urban communities. Yet, as a result of the absence of energy, garment producers mainly use manual ADSMs and WSMs in rural areas. For this reason, electric sewing machines will be used for the discussion in urban communities. Then in rural communities, attention will be given to manual sewing machines.

I. Comparing the production coefficients of the ADSMs and WSMs

I indicated earlier in Chapter 5 above that I will be comparing the level of efficiency of the two alternative machines, as reported by the study firms and then computed for this study, in this and the subsequent chapters. I now proceed with the analysis. In urban communities the study shows a well-behaved production function. Table 7.1 shows an expected higher O/K and a lower O/L for the ADSMs compared to the WSMs in urban communities. However the data I collected in the rural communities show that the WSMs could be labelled as "economically inefficient" considering that they have a lower coefficient of capital and labour (Table 7.1). Thus assuming that product quality is constant, the choice of technique in the urban communities will reflect the factor prices. Conversely, in rural areas there is no set of factor prices that will lead to the choice of the WSMs if the products are homogeneous.

Table 7.1: Summary of the production coefficients of the two types of sewing machines

	Urban		Rural	
	ADSM	WSM	ADSM	WSM
Annual quantities of garment produced	1,728	2,160	864	648
Output/Capital Ratio (O/K) (garment/US$/pa)	11.21	8.82	9.10	4.20
Output/Labour Ratio (O/L) (garment/worker/pa)	9.00	10.00	4.00	3.00
Capital/Labour Ratio (K/L) (US$/pa)	0.80	1.14	0.44	0.70

Source: Base on the Author's fieldwork, 2012-2013

7.2 Capital costs involved in using either an ADSM or WSM

Table 7.2 presents data on the cost differences between the ADSMs and WSMs in garment production at the small scale level. The cost components are divided into fixed and variable costs. The fixed cost is the cost item that does not vary in total even when the output changes—Cost of Machine. The variable cost is a cost that varies with the level of output. This means any increase in output requires an increase in input. Transport, labour, repairs and maintenance, as well as energy cost, are the main variable costs involved at the small scale level (Table 7.2). In Table 7.2 I provide broad aggregation of the cost profile assuming that the variable costs are unchanged from year to year.

However, this does not take into account the uneven yearly incidence of repair and maintenance of the ADSMs and WSMs. Therefore in Section 7.2.2 of this chapter, I will discuss the uneven nature of these two cost items (i.e. maintenance and repair cost). The discussion will be made over the life span of the two sewing machines. Though they constitute a relatively smaller component of the cost structure, repair and maintenance are critical over the entire life span of the machine. In this chapter, I am assuming full capacity utilisation. Small scale garment production is undertaken in both rural and urban communities in Uganda. The table below (Table 7.2) presents the average cost of using the two sewing machines in both urban and rural areas.

Table 7.2: Average annual cost of using the ADSM and WSM (US $/year) (%)

	Electric Treadle (Urban)		Manual (Rural)	
	ADSM	**WSM**	**ADSM**	**WSM**
A. Fixed Cost				
Cost of Machine	61 (13)	88 (14)	34 (8)	54 (14)
B. Variable Cost				
Transport Cost	8 (2)	13 (2)	32 (7)	45 (12)
labour Cost	355 (76)	472 (74)	316 (72)	236 (61)
Repair Cost	21 (5)	30 (5)	45 (10)	36 (9)
Maintenance Cost	6 (1)	11 (2)	12 (3)	17 (4)
Energy Cost	16 (3)	28 (4)	0 0	0 0
C. Total Annual Cost	**468 (100)**	**642 (100)**	**438 (100)**	**388 (100)**

Source: Authors field data 2012-2013, Figures in parenthesis are the percentage share of the cost items

7.2.1 Fixed costs

I. Cost of the sewing machine

The acquisition cost of a machine has become the standard for measuring capital. However, this is not satisfactory since it does not capture the value of capital used within a given period and also does not make allowances for inflationary cost. Thus, the study focuses the analysis on the discounted annual value charged for using the sewing machine. Based on the prevailing real market rates at the time of the data collection, the study employs a discount rate of 9.8 %. Following Kaplinsky (1990) I compute the annual capital cost charged by taking a ratio between discounted acquisition cost and the average discount rate within the assumed life span of the sewing machine.

The study assumes a 10 year life span[12] and a zero scrap value for both ADSMs and WSMs. In total the study sampled 20 brand new ADSMs and WSMs each which the machine operators started using in 2010. Table 7.2 shows that the average annualised

[12] I am aware that after the 10 year period, both sewing machines can be used for a longer period of time. However, for the purposes of easier comparison I considered a 10 year period of operation for both alternative machines.

capital cost of the electric treadle ADSM is US$ 61.00 in urban communities. This constitutes 13 % of the total annual cost of production. That of the WSMs is US$ 88, which is US$ 20 higher than the annual cost of the ADSM. In the rural areas, the cost of a manual ADSM is US$ 34.00 whereas that of the manual WSM is US$ 54.00. The cost of the manual ADSMs and WSMs represents 8 % and 14 % of the total cost of production respectively in the rural areas (Table 7.2). The above description shows that the WSMs are more capital intensive than the ADSMs. This annualised cost for the two sewing machines also captures the cost of transporting the machines after they have been acquired.

7.2.2 Variable costs

I. Transport Cost

Transport costs do not directly affect the smooth operation of the sewing machine, but play a crucial role in determining the final selling price of the garment produced. It is the cost incurred by the machine operator for moving the machine and its parts to a repairer for repair works. Section 6.5 indicates that relative to the ADSMs, a garment producer will have to travel a further distance to access the parts of a WSM in both urban and rural communities. The section estimates the average cost of transport per kilometre in Uganda to be US$ 0.78. I measure the average cost of transporting the machine by multiplying the average transport cost per kilometre by the total distance travelled to access the machine. This is done at both the rural and urban levels. Sewing machine repairers are mostly located in urban areas. This makes the cost of transporting a sewing machine within urban areas for repairs relatively cheaper than transporting the machine from rural areas to a repairer in urban centres (Table 7.2). The average cost of transporting an ADSM and its parts for repair works in urban communities is US$ 8. That of a WSM is US$ 13. Similarly, the cost of transporting the WSMs for rural works is higher than those of the ADSMs.

II. Cost of energy of the sewing machine

Energy infrastructure is one of the key factors influencing garment producers use of an electric treadle sewing machine in the urban communities. Rogale *et al.* (2005) indicate that using electricity for sewing speeds up the sewing machine and thus increases productivity. This leads to an increase in the value and productivity yields in garment production (Rogale *et al.* 2005). However, this also means that the garment producer will incur energy cost. Measuring the cost of energy consumed by a sewing machine is difficult. The first issue is that garment producers do not have any system for measuring energy cost per sewing machine. The monthly electricity bills include all the other equipment such as pressing irons and electric cutters that are available at the tailoring shop. This issue is compounded by the fact that both the ADSMs and WSMs use a 5hp electric motor for sewing. In situations where there are two or more small scale garment producers sharing the same electric meter, the producers share the electric bills using a system I describe as a *points system.* I use the *points system* to distinguish between the energy consumption rates of the two types of sewing machines in consideration.

The *points system* is a crude method of rating the amount of power an electrical appliance consumes. The higher the amount of electricity consumed by the electrical appliance, the more points it gets. The challenge with the *points system* is that it does not capture obsolescence of the equipment as cautioned by Stewart (1982), given that obsolete capital equipment is more likely to consume more energy than relatively new ones. Thus, the study assumes that the WSMs and ADSMs have a rate of 2.0 and 1.2 respectively. This assumption is based on the fact that the WSMs weigh[13] more than the ADSM. In comparing the energy cost, the study adopts the points system with the assumption that the alternative machines are in the same condition.

Using the Electricity Regulatory Authority of Uganda's end user tariff rate for 2012, energy consumption at the small scale garment production level is in the category of

[13]Note that energy requirement is directly proportional to the mass of an object (Perrett and Jeffery, 1922).

low voltage supply for small general services. This category involves electricity supplied to residential houses, small shops and kiosks, etc.—metered at low voltage single phase and supplied at 240 volts (see http://www.umeme.co.ug/index.php?page=ODI=; accessed on 15/11/2012). In this category, the consumer pays US$ 0.036 for the first 15 kilowatts hour (Kwh) of energy consumed (see http://www.umeme.co.ug/index.php?page=ODI=; accessed on 15/11/2012). Since the two technologies use 5 hp electric motors for garment production, it was difficult to use only the motors in isolation to make any meaningful comparison. However, factoring the points system into the equation and converting the horsepower of the electric motor into kilowatts makes it possible for comparison.

It is necessary to note that 1 horsepower hour is equivalent to 0.746 kWh (FAO, 1997). In addition, all things being equal an electric motor cannot operate to its full capacity. On average, electric motors operate with a maximum load factor of 75 % (FAO, 1997). According to the United States Congress (1993) a load factor is the average percentage of full operating power that the electric motor uses. Hence, the study assumes a load factor of 75 % for the electric motor and an average 8 hour machine working period per day. Therefore taking into account the load factor of the electric motor, a 5 horsepower motor will consume a maximum of 2.80 kilowatts hours of power a day.

The results show that garment producers who use electric treadle ADSMs spend an average of US$ 16.00 per annum on energy. On the other hand, users of electric treadle WSMs spend approximately US$ 28.00 per year on energy. Garment producers in the rural communities do not incur cost mainly because there is no electricity infrastructure. The study takes note of the fact that garment producers in rural communities use their man-power for the production process; however, this has already been captured as compensation for labour and as such the study only focuses on energy consumption in urban communities.

Repair cost

Another important component of the cost structure of garments production is the repair cost of the sewing machine. The study estimated cost of repair using two key indicators—the average cost of spare parts and the rate charged by the sewing machine repairers per repair session. As indicated in Section 7.2 earlier, the cost of repairs is uneven. The cost may depend on different factors. It may depend on the extent of damage as well as the level of complication associated with the damage (Interviews, 2012). The repairer will charge a higher rate if he (there were no female repairers) encounters more challenges during repairs and vice versa. Again, the machine owner will have to incur higher repair costs if the part of the machine to be replaced is relatively expensive (field interviews, 2012). As the machine ages, repair work becomes more frequent because of an increased rate of wear and tear on the machine. This leads to an increase in the cost of repairs of the machine. All these factors make the repair costs of the machine uneven over the lifespan of the machine. Table 7.3 shows how the cost of repairs varies from year to year.

Table 7.3: Breakdown of annual cost of repairs for ADSMs and WSMs (US$/year) (N= 20)

Location		Year										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
Urban	ADSM	14	15	16	18	20	21	24	26	28	31	21
	WSM	19	21	23	25	28	30	34	37	40	44	30
Rural	ADSM	29	31	34	38	41	45	50	55	60	66	45
	WSM	23	25	28	30	33	36	40	44	48	53	36

Source: Base on the Author's fieldwork, 2012-2013

Field data from the 147 firm I sampled shows that the ADSMs on average breakdown twice a year whereas the WSMs break down on average once every two years. Nevertheless, the average annual cost of repairs for the ADSMs in urban communities is lower than that of the WSMs (Tables 7.2 and 7.3). This is because the ADSM spare parts are cheaper and easier to access compared to the WSMs. In addition, the WSM is more sophisticated and difficult to repair. In view of that repairers charge higher rates to repair the WSMs (as is visible from the costs outlined in Table 7.2). Thus, despite the greater durability of the WSM, its annual cost of spare parts and repair fees exceed those of the ADSM. In the urban communities, users of WSMs spend an average of US$ 30 a year on spare parts and repair works (Tables 7.2 and 7.3). On the other hand, users of ADSMs spend an average of US$ 21 annually on parts and repair works (Tables 7.2 and 7.3).

Unlike the urban communities, the cost of repairs on the ADSMs is higher than the WSMs in the rural communities. Wright (2001) indicates that the many problems associated with sewing machines are caused by dust, lint or thread ends. The robust nature of the WSMs enables it to withstand the dusty environment in the rural communities to a greater extent than the ADSMs. In rural communities the ADSMs break down on average three times a year whereas the WSMs only break down on average once per year (Tables 7.2 and 7.3). On average, an ADSM user in a rural area spends almost US$ 45 per year on repair works while users of the WSMs in rural areas spend only US$ 36 per year (Tables 7.2 and 7.3).

Skills demand for repair works

There is generally high demand for repairers due to their limited number in the local market. Interviews with the five sewing machine repairers show that out of an average weekly receipt of 25 ADSMs, they are only able to repair 15 of them. This means that repairers will not be able to repair 40 % of the total ADSMs they receive. A sewing machine repairer spends an average of three hours to repair an ADSM. They are also able to repair five out of an average weekly receipt of 15 WSMs. This means that a repairer will spend an average of eight hours per day to repair only one WSM. The resultant effect is that the repairers are able to repair only 33 % of the WSMs they receive a day. A sewing machine repairer in Kampala explains that

> *"this week alone I have more than 20 Chinese machines to repair my customers are all on me.....we* [repairers] *are very few here so there is a lot of pressure on*

us. This is the main place where people repair their machines" (Base on field interviews in 2012).

In some cases, the machine users end up abandoning the sewing machines (particularly the WSMs) when the repairers are unable to repair the sewing machines. This is as a result of the complex nature of the machine damage or in some cases challenges in getting sewing machine parts.

A garment producer at Kiyembe-Kampala indicates that

> *"I bought a Singer sewing machine from the United Kingdom in 2006.....I really enjoyed using that machine.......but it got damaged last year* [2011] *when my shop got burnt.....I sent it to different repairers but none of them were able to repair it.....I had to abandon it because the damage was too complicated.....".*

The repairers are mainly located in these communities because they are able to access energy for the equipment they use for the repair works. Thus, the few repairers available are overburdened with lots of repair works.

Both types of machines require skills in repairs in order to sustain their use. Contrary to standard literature that AD technologies are less skills intensive (Clark *et al.* 2009, and Kaplinsky, 2010) the frequent breakdown of the ADSMs has demand implications for repair skills. Thus, users of the ADSMs can easily lose valuable clients compared to those who use WSMs since they may not be able to get their machines back from the repairers on time for production. An ADSM user in Kiyembe in Kampala indicated that

> *".........my machine* [ADSM] *was not working* [broken down] *during the Christmas holidays....but I had a lot of work to do for my customers.....So I disappointed them......they don't bring their material for me to sew again.....I lost them as my customers.....all my friend who use the British machines did a lot of work* [sewing]*"* (Base on field Interviews in 2012).

As outlined above the lack of qualified repairers mean that there is a similar – if not greater – issue of client loss and machine loss for ADSMs. In addition, the skills problem here is not just an issue of the nature of qualifications but the number of those with the skills to repair the machines – of both types.

III. Maintenance cost

Most problems associated with sewing machines can be traced to a high concentration of dust, lint or thread ends that have collected on the working parts of the sewing machine (see Chapter 5). A proper maintenance culture of the sewing machine to some extent can avert these problems. Depending on the extent to which the sewing machine is used, garment producers will have to maintain it accordingly. I observed that the garment producers use soft nylon brushes to dust away lint from under the needle plate and around the feed dog of the sewing machine. The bobbin of the sewing machine is also another place where lint and fuzz accumulate. Regular replacement of the throat plate, blunt and broken needles, bobbin case and bobbin housing (hook mechanism) of the sewing machine is also vital to keep the sewing machine efficient (Wright, 2001). After that the sewing machine should be oiled for proper lubrication and then covered immediately after use (Wright, 2001).

The cost of items that are used by the garment producer for maintenance activities vary between the two sewing machine technologies. On the Ugandan local market, the cost of 125ml oil is US$ 1.07. In the urban communities, users of ADSMs require an average of 125 ml of oil to lubricate the machine every quarter of the year. In addition, they require three packets of needles every year for proper maintenance of the machine. Each packet of ADSM needles costs US$ 0.71. Therefore, the ADSM user will have to spend an average of US$ 2.14 annually on needles. The WSM users also require 250 ml of oil to lubricate the machine every quarter of the year in rural communities. However, the WSM requires only one packet of needles annually. Each Western made needle costs an average of US$ 2.86.

The difference is due to the frequent breakdown of ADSM needles relative to that of the WSM. Similar to the repair cost, the annual cumulative cost of maintenance of the WSMs is higher than that of the ADSMs. In urban communities, the average maintenance cost of WSMs is US$ 11.00 whereas that of the ADSMs is US$ 6.00 (Table 7.2). The maintenance cost is higher for both technologies in rural communities relative to those in urban communities. Cost of maintenance for the WSMs is US$ 17.00. The cost of maintenance for the ADSM in rural communities is twice (US$ 12) the cost of its maintenance in urban areas (Table 7.2). This is due to the higher level of wear and tear of the technology as a result of the high level of dust concentration in the rural communities. For instance, the ADSMs require a lot of maintenance in terms of lubrication and frequent replacement of needles. A garment producer in Kiyonga, a rural community in Jinja explains that *"the dust is our serious problem.....it causes a lot of damage to our machine....we always oil it"*.

Aging machines also tend to breakdown more frequently because of wear and tear. As such; the operator will end up spending more resources for maintenance work on the machine. This makes the level of expenditure on maintenance of the two sewing machines vary year by year (Table 7.4). Specifically, the cost of annual maintenance for an ADSM in rural areas will increase from US$8 per annum in the first years of use to US$18 per annum by the time the machine is 10 years old. Likewise, those of the WSMs in rural areas will increase from US$11 at the end of their first year to US$25 by the time they are 10 years old. In the urban areas, annual cost of maintenance for an ADSM and WSM will respectively increase from US$ 4.00 per annum and US$ 7.00 per annum in the first year of use to US$ 10.00 per annum and US$ 17 per annum in the tenth year of using the machine.

Table 7.4: Breakdown of annual maintenance cost for the two sewing machines (US$/year) (N=20)

Location		Machine Life Span (Years)										
		1	2	3	4	5	6	7	8	9	10	Average
Urban	ADSM	4	5	5	5	6	6	7	8	9	10	6
	WSM	7	8	9	10	11	11	13	14	15	17	11
Rural	ADSM	8	8	9	10	11	12	13	14	16	18	12
	WSM	11	12	13	14	15	17	19	21	23	25	17

Source: Base on the Author's fieldwork, 2012-2013

IV. Labour cost

The study uses remuneration of employees for the measurement of the cost of labour. Labour compensation is based on the number of garments that are produced per day—that is on a 'piece work' basis at the small scale level. The field data shows that operators of both ADSMs and WSMs work for an average of eight hours per day and each employee earns US$ 0.36 per garment produced. Again, a sewing machine operator produces more garments with WSMs than the ADSMs when the machine is powered with electricity. The ADSMs experiences frequent breaks during production mainly because of frequent rethreading, needle breaks, as well as oiling (see Chapter 5 above and the last section discussion). Therefore, based on the figures received during my fieldwork, for the operators I interviewed, WSM operators in the urban communities earn more income than those who use ADSM. On average, an ADSM operator earns US$ 355 per annum (Table 7.2). This is lower than a WSM operator who earns an average of US$ 472 per annum (Table 7.2).

The situation is different for those in rural communities. The bulky nature of the manual WSM makes its operation more laborious than that of the ADSMs (as indicated in Section 5.2.2 above). The manual ADSMs on the other hand are less bulky; as such it is easier for the operator to operate compared to the WSMs ones. Thus, operators using ADSMs are able to produce more garments in the rural communities than those using WSMs. On average, an operator of manual ADSMs earns US$ 316 whereas those who use manual WSMs earn US$ 236 annually (Table 7.2).

7.3 Comparing the output of ADSMs and WSMs

The amount of value addition and quantity of garment produced is captured in this section by using a medium sized "kitenge shirt" as a standard for measuring the output of both technologies. A "kitenge shirt" is a low-cost, informal piece of garment that is decorated with different colours, patterns and in some cases political slogan. Figure 7.1 presents a picture of the "kitenge shirt" I used as a standard for the measurement of output.

Figure 7.1: A medium sized "kitenge shirt"

Source: Picture taken during author's fieldwork, 2012-2013

As indicated in Chapter 5 above, the location of the garment firm affects the quantity of garments that can be produced within a given period. A garment producer in an urban area is able to access energy to speed up garment production, assuming they have the funds to pay for electricity. Producers in rural areas on the other hand have no access to energy infrastructure and as such the rate of production is generally slower when compared to those using electric powered machines in urban areas. Again, the amount of value added to a garment is determined by the appearance and performance of the garment. A good appearance of a garment shows on the seams—this normally requires smooth fabric joins with uniform stitches (Aldrich, 1994 and Carr and Latham, 1994). Conversely a good appearance of garments occurs when the seam has achieved strength, durability, security and comfort (Aldrich, 1994 and Carr and Latham, 1994).

Though both the ADSMs and WSMs in urban areas use a 5 hp electric motor, I observe that the WSMs work faster than that of the ADSMs. The 5 hp electric motor enables both sewing machines to work at 1800 revolutions per minute (rpm) (Brother Sewing Machine Manual, 2009); however, the speed partly leads to skipping of stitches as well as occasional breakdown of some parts of the ADSMs. This leads to delays; and reduction in quality and quantity of output of the ADSMs relative to the WSMs. A sewing machine repairer indicates that

> *"I always advise the tailors not to fix the motor* [5 hp electric motor] *on the China machines......they are too light* [less bulky] *for the speed* [1800 rpm]*......that is why they break needles frequently".*

Therefore, when using the ADSM for the production of garments, a lot of skills are required in handling the machine to avoid fabric damage. A small scale garment producer indicates that

> *"you need to be very skilful and experienced enough to be able to able to use the ADSM.....before you can sew with no errors".*

The difference in output is due to the continuous interruption as a result of frequent replacement of broken needles, rethreading and frequent oiling of the ADSMs. This causes delays when using the ADSMs for production. As early as the 1970s, it was recognised (Grills and Brown, 1975) that an operator will have to spend time to make good a fault incurred in the sewing operations. This affects the quantity of a garment and reduces the value of the garment produced with the ADSM. Data from the 147 firms I sampled show that both technologies use a daily average of 30 yards of fabric in the urban communities. However due to their frequent mechanical issues, the ADSMs add relatively lower value to the garment. Furthermore relative to the WSMs, this issue also makes the ADSMs produce fewer quantities of garment. Based on the figures received from those I interviewed for this study, the ADSMs produce an average of 8 medium sized "kitenge shirts" a day (1728 "kitenge shirts" per annum) and that of a WSM is capable of producing 10 medium size "kitenge shirts" a day (2160 "kitenge shirts" per annum). A "kitenge shirt" produced with an ADSM will add an average value of US$ 0.77 and that of the WSM is US$ 0.88 (Table 7.5). This is based on what is possible to complete in a single shift of eight hours during the day; the normal operating hours of those I interviewed. It should be noted that this does not mean some operators in the country do not produce more or less than this or work different shift patterns and therefore my calculations here are specific to the situations I observed during my fieldwork. However, they are important because they give a clearer picture – not otherwise available – of the implications of garment production at the small scale level on poverty reduction.

Unlike the urban communities, the two technologies—ADSMs and WSMs—are manually operated in rural communities. Ideally, the WSMs are mainly meant to operate with electricity but they can easily be used manually by detaching the 5 hp electric motor from the machine. However this comes with some challenges which affect the output of the garment (Interviews, 2012). Without the required pressure on the fabric from the presser foot[14], the feed dog[15] of the sewing machine cannot do its job efficiently. This prevents the fabric from feeding through; causing jams and damages to the fabric and hence reducing the quantity of the garment to be produced per day (field interviews, 2012). Again as indicated in Chapter 5 above, garment producers in rural communities use paper makers for the production of garments. Therefore as noted

[14]The bulky nature of the WSMs makes it difficult for the operators to exert pressure on the presser foot and this causes a malfunctioning of the feed dog.

[15] The feed dog of the sewing machine is responsible for pulling the fabric through the machine in discrete steps, in-between stitches.

earlier in Chapter 5 (Section 5.2.1 above), correcting errors on paper markers are difficult, time consuming and compromise the value that is added to the garment. A garment producer in Kiyonga, a village close to Iganga in the Eastern region of Uganda indicates that

> *"we only use paper and markers for the designing.....it wastes a lot of time and you can make a lot of mistakes".*

Though the two sewing machines are generally slow when operating manually the ADSMs are relatively more efficient. The manual treadle WSMs and ADSMs respectively produce three and four "kitenge shirts" within eight hours a day in rural communities based on the data I collected. However, in terms of value addition there is no difference between the two technologies at the rural level. Table 7.5 highlights the level of value addition based on a calculation percentage of output and waste generated by the two types of sewing machines—an ADSM or a WSM. This is not the waste caused as a result of labour errors but due to mechanical issues related to the sewing machine. I compute this by taking the difference between the fabric lengths after cutting has been made and the actual length that goes into the production of the garment expressed as a percentage. This is on the assumption that both technologies use homogeneous fabric to produce homogeneous output. The total annual value of the garment produced by the WSMs is higher than the ADSMs. However, the total value of garments produced by the in rural communities WSM is lower than that of the ADSM (Table 7.5).

Table 7.5: Annual level of output of the two sewing machines

	Urban		**Rural**	
	ADSM	**WSM**	**ADSM**	**WSM**
Length of fabric used (Yards/year)	6,480	6,480	2,592	2,592
Length of fabric after cutting (Yards/year)	5,848	5,910	2,315	2,315
Percentage of fabric waste (%)	5.00	4.00	6.00	6.00
Annual quantity of garment produced	1,728	2,160	864	648
Value added/garment (US$)	0.77	0.88	0.69	0.69
Total Annual Value (US$)	1,331	1901	596	447

Source: Based on the Author's fieldwork, 2012-2013

7.4 Private profitability of the ADSMs and WSMs

I now use the various costs and benefit components described above to compare the private profitability for the machines that I reviewed in this study based on the data I received during fieldwork. I consider the rate of return in using the two technologies.

7.4.1 Comparing the rates of return of the two technologies

Two key discounting measures were used to compare the returns of the two technologies—Cost-Benefit ratio and Net Present Value (NPV) (Gittinger, 1982). These discounting measures enable the study to take into account changing costs and revenue over time. It also facilitates easy ranking of the two technologies in terms of their levels of returns (Gittinger, 1982). The study uses the prevailing real market interest rate of 9.8 % (at the time of my research) for the computation of the present values of the sewing machine technologies.

7.4.2 Net present value of the ADSMs and WSMs

NPV considers the revenue and cost flows to examine whether technologies may be able to pay for themselves. Thus NPV considers the difference between the discounted benefit and discounted cost. A positive NPV indicates that the project may be able to pay for itself and vice versa if the NPV is negative (Gittinger, 1982). Therefore, the formal criteria for selecting a technology using the NPV is to identify the one with a positive NPV when discounting it at the opportunity cost on capital. I use the various cost components above to estimate and compare the present values of all the cash inflows and outflows of the two technologies. This was discounted at a rate consistent with the prevailing risk associated with the technologies. It is essential to note that this discounting measure is not suitable for ranking the technology in terms of returns—it is an absolute and not a relative measure (Gittinger, 1982). Table 7.6 shows that using both technologies in the urban and rural communities can pay for their investments. However, the NPV for the WSMs is higher than those of the ADSMs in urban areas.

The reverse holds when it comes to the rural communities—the NPV for the ADSMs is superior to that of the WSMs (Table 7.6).

Table 7.6: Annual rates of return for the two alternative sewing machines

Location	WSM	ADSM
Urban		
NPV (US$)	111	79
CBR	1.12	1.02
Rural		
NPV (US$)	20	41
CBR	0.49	1.03

Source: Computation based on field data, 2012-2013

7.4.3 Cost-Benefit Ratio (CBR)

By definition, a CBR is a ratio between the present value of the benefits and costs of a project (Gittinger, 1982). This shows how well the technology can pay for itself. I do this by taking a ratio of the NPV and the cost of investing in the technology. Since the NPV discounts to the year of investment, both the NPV and investment costs are comparable. Thus if the CBR is equal to or greater than 1 then it implies returns on the technology are positive. However, if the technology is less than 1 then it means the cost incurred in using the technology is greater than the net benefits; thus the technology cannot pay for itself. (Gittinger, 1982). Table 7.6 above shows that WSMs are more profitable than the ADSMs in the urban communities. However in the rural communities, the ADSMs are superior to the WSM. Therefore though they are capital intensive (see Section 7.2.1), the WSM is able to pay for itself better than the ADSM in the urban communities and vice versa in rural communities.

Going back to Chapter 6 above, I realise that the distribution of the AD garment making technologies is wider in both urban and rural areas. As indicated in available literature in Chapter 2 above, the distribution of a technology should reflect its level of profitability (Mansfield, 1968 and Arrow, 1962). Therefore as expected the wider distribution of the AD garment making technologies in rural communities reflects their level of profitability. The Western garment making technologies are less distributed in rural communities with lower levels of profitability. However, the level of distribution of the AD garment and Western garment making technologies in urban areas do not reflect their level of profitability. This may be attributed to the frequent delays that are experienced with the AD technologies during garment production. Hence I reject the assumption that the distribution of technologies reflects their level of profitability.

7.5 Conclusion

This chapter measures the private profitability of garment making technologies using ADSMs and WSMs as a case study. The chapter takes an in-depth analysis of the workings of the machines and the costs involved. In so doing, it then allows for the calculation of NPV and CBR for the two different types of machines. Such calculations are important because it enables the study to quantify and compare the amount of returns that is generated by the two machines—ADSMs and WSMs—being used by my respondents. These calculations further provide a clearer picture of the differences in the use and appropriateness of the different technologies being used by those I interviewed. As will be discussed in Chapter 10 this has implications for policy and theory in the area of Asian Driver technology promotion as a means of poverty reduction.

The chapter concludes that using ADSMs in the rural communities is more profitable with positive implications for job creation. The WSMs appear to be more profitable in the urban communities; but in the rural communities, the operators who use ADSMs will realise higher returns when compared to the manually operated WSMs. Therefore I conclude that in addition to other criteria that have been identified in standard literature, the appropriateness of a technology should also be examined in the context of the location where the technology will be used. This is because though the WSMs at the small scale level are capital intensive, it recorded a higher rate of return than the ADSMs in the urban communities; but the reverse is true in rural communities.

CHAPTER 8: PRIVATE PROFITABILITY OF LARGE SCALE GARMENT MAKING MACHINES

8.0 Introduction

In this chapter, I estimate the private profitability of industrial ADSMs and WSMs at the large scale level. As indicated in Chapter 6, this chapter focuses on the 11 large scale garment making firms that were sampled for the study. Data on acquisition cost and revenue that is accrued as a result of using sewing machines to produce garments was ascertained from accountants and managers of each firm sampled for the study. The study restricts the discussion on large scale garment production to the urban areas. This is because large scale plants are confined to the use of energy infrastructure in urban areas in Uganda (Chapter 6). This chapter argues that, in the case of these firms, the private profitability of the industrial WSMs is superior to that of the ADSMs in commercial garment production. Furthermore because the ADSMs are cheaper and easier to use, the local firms are able to hire more unskilled labour compared to the AD and Western owned firms. Section 8.1 discusses the physical properties of the two types of sewing machines. These physical properties focus on the cost of capital and labour, and the output of the two types of machine. This is followed by a discussion on the cost implications of using an industrial ADSM and WSM for garment production in Section 8.2. Section 8.3 compares the output of both technologies. This is followed by a discussion on the rate of return of the two types of sewing machines in Section 8.4. Section 8.5 concludes this chapter.

8.1 Production coefficients of the two alternative sewing machines

This section follows the procedure and assumptions that were made in Chapter 7 to estimate the production coefficients at the large scale level. Table 8.1 sets out the factor productivities of the two types of sewing machines—industrial WSMs and ADSMs. The relatively high capital cost of the industrial WSMs is reflected in the productivity coefficients of the two technologies. Table 8.1 shows that the capital productivity of the

WSM is higher than that of the ADSMs in the firms studied. However labour productivity for the ADSMs is superior compared to the WSMs. Therefore, both technologies are economically efficient at the large scale level. This is similar to the results that were obtained for the two types of sewing machines in urban areas at the small scale level. This may explain the fact the WSMs cannot be superior to the ADSM in terms of economic efficiency unless there is the presence of energy infrastructure. Garment producers employ industrial WSMs for the production of garments despite the fact that it is more capital intensive. This can be attributed to the fact that the industrial WSMs add more value to the garment than the ADSMs (see Chapter 5).

Table 8.1: Summary of the production coefficients of the two types of industrial sewing machines

	ADSMs	WSMs
Annual quantity of garment produced	2688	3264
Output/Capital Ratio (O/K) (garment/US$/pa)	9.12	6.00
Output/Labour Ratio (O/L) (garment/worker/pa)	14.05	17.10
Capital/Labour Ratio (K/L)(US$/pa)	2.12	3.31

Source: Author's Computation, based on data collected for fieldwork, 2012-2013

8.2 Cost implications of using the ADSMs and WSMs at the large scale level

Similar to the preceding chapter, I categorise the cost components for using the industrial sewing machine into two main groups—the fixed and recurrent cost of the machine. The fixed cost is the annualised cost of the machine (Table 8.2). Table 8.2 maintains the assumptions in Chapter 7 that the recurrent costs are unchanged from year to year, relaxing this assumption in later discussion. The main recurrent cost items comprise of the transport cost for repair works, repair and maintenance cost, energy and labour. Table 8.2 below provides a detailed annual cost component of the two technologies based on data from the 11 firms studied.

Table 8.2: Average annual cost components in large scale garment production per year (US$ /year)

Items	WSM	ADSM
Fixed Cost		
Annual cost of capital	200 (26)	109 (16)
Recurrent Cost		
Transport Cost	11 (1)	15 (2)
Maintenance Cost	41 (5)	60 (9)
Repair Cost	66 (9)	112 (17)
Energy Cost per year	32 (4)	27 (4)
Labour Cost per year	411 (54)	343 (52)
Total	**762**	**665**
Total percentage	100	100

Source: Authors field data 2012-2013, Figures in parenthesis are the percentage share of the cost items

8.2.1 Fixed cost

I. Measuring the annual value of the sewing machine

The study follows the approach I used in Sections 7.2.1 and 7.2.2 to compute the annual cost charged for the sewing machine. As indicated above all the assumptions that were made for the computation of the annual cost of the machine in Chapter 7 also apply to this chapter. Similar to the small scale machines, the annual value of machines used also captures the cost of transporting the machine after acquiring it. The cost of ADSMs was obtained from the local firms whereas that of the WSMs was obtained from both the Western and AD owned firms. The annual value of an industrial ADSM and WSM is US$ 200 and US$ 109 respectively. This represents 26 % of the total annual cost of producing a garment using WSM (Table 8.2). In the case of the ADSMs the annual value used represents 16 % of the total production cost.

The AD and Western owned firms predominantly use WSMs for production. This is mainly because they are more conversant with the WSMs and also because the WSMs are more robust than ADSMs. The CEO of Phenix Logistics a Japanese owned firm explains that

> *"we bring all our sewing machines from Japan and sometimes Germany.....you see, they are very robust and we have been using it for all these years....we are used to it...it is also reliable"* (Based on field Interviews, 2012).

Also, the CEO for Sigma Knitting Limited an Indian owned firm indicates that

> *"Oh yes, you cannot go for Chinese if Japan and Germany are available.....in Engineering, Germany are the best they have first class technology, first class metalogy which I don't need to test. They use rugged metal, Japanese use recycled metal and China uses rubbish"* (Based on field Interviews, 2012).

Though they recognise that the industrial WSMs produce better quality garments, the local firms use the ADSMs for large garment production. The main reason as identified by 4 out of the 5 production managers that were interviewed is that the ADSMs are less capital intensive and so it is easier to acquire more of them to expand their business. The production manager of Kwera garments, a Ugandan owned garment making firm explains that

> *"we want to expand the business ....so we buy more Chinese machines.....this is because they are cheaper.....we wish to rather get more of the European machines because they are good and strong but they are too expensive. The cost of one European machine can buy three Chinese machines....so you see we can expand this business with the China machines"* (Based on field Interviews, 2012).

The demerit is that relative to the WSMs, the ADSMs produce weaker stitches. This is partly the reason why I indicated in Section 5.2.2 that garment producers will only be able to produce lower quality garments per period of time if they use ADSMs. This may affect a firm's ability to meet agreed contract deadlines.

8.2.2 Variable costs

I. Cost of repairing industrial sewing machine

This section follows the approach in Section 7.2.2 to estimate the cost of repairs for the industrial sewing machines. Similar to the small scale machine, the industrial ADSMs break down twice every year and that of the WSM once every two years. As indicated in Chapter 7, dust is the main cause of frequent breakdown of both technologies (field interviews, 2012). Another cause of breakdown of industrial machines is the frequent fluctuation of electrical current during the process of sewing. Yet, spare parts for WSMs are not readily accessible on the local market and so the garment producers using WSMs import them from South Africa. This is partly because most of the garment producers operate on a small scale basis, and do not use the industrial sewing machines. An accountant at Phenix explains that

> *"the manufacturers of these machines have a subsidiary in South Africa...so we go there to be able to get the original parts".*

The ADSMs have a weaker electric motor than that of the WSMs which is more vulnerable to frequent fluctuation of electric power in the country. A firm will have to incur more cost in order to access new motors for repair works on the ADSMs. A technician at Kwera Garments, a local garment producing firm in Kampala indicates that

> *"the only problem I have with this machine* [ADSM] *is the weak motor...I report of damaged motor every week".*

Again, different repairers charge different rate for their repair works. On average, repairers charged higher rates for repairing WSMs than ADSMs for the large scale firms that I interviewed. I observed that the machine repairer was always wary of the fact that during repair works, he could easily damage the machine further. When this happens, he would be responsible for the cost of damage. As noted above, the WSM and its parts are more expensive than the ADSMs. Therefore relative to the ADSM, it is riskier for a repairer if he further damages a WSM (compared to an ADSM) since he is likely to incur higher cost. Hence, the repairers charge higher rates for repairing the WSMs. In addition the Western made machines are complicated and require more time to diagnose and solve the identified problems. Furthermore as the machine ages, the level of wear and tear also increases. These issues make the cost of repair vary year by year over the lifespan of the machine (Table 8.3). Specifically the cost of repairing an industrial ADSM will increase from $71 by the end of the first year of use to $164 by the time the machine is 10 years old (Table 8.3). Though the cost of repairs for the industrial WSMs is relatively lower than that of the industrial ADSMs, the annual cost of repairs is also uneven (Table 8.3).

Table 8.3: The uneven nature of the cost of repairs (US$ /year) (N=20)

	Life span of the Machine (years)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
ADSM	71	78	85	94	103	113	124	136	149	164	112
WSM	42	46	50	55	61	67	73	80	88	97	66

Source: Author's fieldwork, 2012-2013

Interviews with technicians show that each machine operator can repair an average of five industrial ADSMs weekly. In the case of the WSMs each repairer can repair three of them weekly (Interviews, 2012). Table 8.2 above shows that the average cost of repairs for an industrial ADSM is US$ 112 and that of an industrial WSM are US$ 66 per year.

II. Maintenance cost of industrial sewing machine

Similar to the discussion in Chapter 7, I use the cost of lubricants and the breakable parts of the machine like needles, the needle bar, hook race, bobbins, etc. to measure the cost of maintenance. Oiling the machine parts regularly is very important for proper speed, pressure and heat applications of the sewing machine (Carr and Latham, 1994). On average a WSM consumes 300 millilitres of oil a month relative to 500 millilitres for the ADSMs (field interviews, 2012). In addition, the needles of the industrial ADSM break more frequently than the WSMs, as such firms that use the industrial ADSMs make use of more needles than those who operate with the industrial WSMs. On average, an operator of an industrial ADSM and WSM respectively uses three packets and one packet of needle a year for the production of garments. This results in an increase in the maintenance cost of the ADSM to US$ 60 relative to the WSM of US$ 41(Table 8.2 and 8.4). The cost of maintenance depends *inter alia* on the age of the machine, the rate at which the machine works and the level of dust concentration in the environment in which the machine is located. Changes in any of these factors can vary the cost of maintenance from year to year (Table 8.4). Specifically, the cost of maintenance of an ADSM increases from US$ 38 during the first year of use, and this will increase to US$ 88 per annum by the 10th year of use. Similar, it will cost an industrial WSM operator US$ 26 per annum to maintain his sewing machine in the first year of use. This figure will increase to US$ 60 per annum by the time the machine is 10 years old. No cost was recorded for the cleaning of the machine; however, it requires proper cleaning to ensure efficient operation.

Table 8.4: The uneven nature of the cost of maintenance for the two alternative technologies (US$/year) (N=20)

	Life span of the Machine (years)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
ADSM	38	41	45	50	55	60	66	73	80	88	60
WSM	26	29	31	34	38	41	45	50	55	60	41

Source: Author's Fieldwork, 2012-2013

III. Transport cost of the sewing machine

As indicated in Chapter 7 above, the cost of transport does not directly affect the performance of the sewing machine. It rather affects the repair costs of the garment producer. Data from the 11 large scale firms show that on average the firms incur costs for transporting spare parts to technicians for repair works (Interviews, 2012). This section captures the cost of transporting machine parts under transport cost (see Table 8.2). In relation to the industrial WSMs, the fact that the ADSMs frequently break down means producers will incur more cost for transporting the spare parts of the machine. On average, it will cost a garment producer US$ 15 per annum to transport an industrial ADSM part for repair work. On the other hand, the industrial WSM operator requires only US$ 11 per year to transport the parts of the machine for repair works.

IV. Energy cost of the sewing machine

Chapter 5 explains the importance of energy in garment production. Unlike the small scale garment producers who are able to produce garments without power, the large scale garment producers rely solely on electricity since the sewing machines can only operate with the use of electric power. Using electric power enables the machines to operate faster hence, producing enough garments to meet pressing deadlines. This explains why all the large scale garment firms are located in the urban communities. The large scale garment producers also pay their monthly bills in bulk; so they find it difficult to identify the energy consumption pattern of each sewing machine technology.

Kwera Limited has made a compilation of their energy consumption patterns for the various garment making technologies in their firm. The study adopts the Kwera data for measuring the cost of energy for both ADSM and WSM technologies. This is due to difficulties in accessing data on energy from the other large scale firms. In view of this I relax the *points base system* assumption that I made in Section 7.2.2. According to Kwera Garments Limited the industrial WSMs consume an average of 550 watts of power whereas that of the industrial ADSMs is 373 watts. According to UMEME[16], the average monthly tariff rate for low voltage supply to commercial enterprises is US$ 0.163 per kWh. In view of this the study measures the annual cost of energy by taking the annual energy consumption and the unit cost of the energy tariffs as specified by UMEME (see http://www.umeme.co.ug/index.php?page=ODI=). Based on the above computations the study shows that the energy cost for the industrial ADSMs is US$ 27 representing 3.5 % of the total cost whereas that of the WSM is US$ 32 constituting 4.8 % of the total cost stream (see Table 8.2).

V. Measuring the cost of labour

The large scale firms employ supervisors at each stage of the production process (see Figure 6.2 for the various stages of the serial production process). I consider both

[16] UMEME is the power producing company in Uganda

casual and supervisory labour at the large scale level. In general, the firms employ more casual workers than permanent workers (Table 8.5). The sewing department is the highest employer of the casual workers in each of the firms (field interviews, 2012).

Table 8.5: Number of workers in the three categories of large scale firms

Number of Workers	Permanent/Supervisory	Casual	*Average*
Local Firms	15	250	133
Western Firms	25	80	53
AD Firms	30	150	90

Source: Author's Computation, based on data collected for fieldwork, 2012-2013

Table 8.6 below shows the average number of workers at the sewing department of a large scale firm in Uganda. Machine operators (i.e. both casual and supervisory) work for eight hours daily in the 11 firms studied. The supervisors' role is to ensure that the machine operators sew the garment according to the specified pattern and design. They also train the operators on how to operate both machines (particularly the industrial ADSMs) to reduce damage to the fabric. This helps the local machine operators to acquire on-the-job skills and tacit knowledge in garment machine operations.

Table 8.6: Composition of labour and its related cost (US$)

	Ave. annual Person-days	Rate/day (US$)	Annual Cost (US$)
Firms with WSMs			
Permanent/Supervisory	240	3	686
Casual	144	1	206
Average	**192**	**2**	**411**
Firms with ADSMs			
Permanent/Supervisory	240	2	514
Casual	144	1	206
Average	**192**	**1.5**	**288**

Source: Author's Computation, based on data collected for fieldwork, 2012-2013

The manager of Kwera Garments explains that

> *"this machine is from China........it is simple to use but we give train them* [casual workers] *on how to handle it during sewing otherwise they will destroy the material with it........the needle* [ADSM needles] *is not good so it can break easily and destroy the material".*

On average, in the 11 firms studied, the casual workers work for an average of 144 days per year whereas the supervisors work for 240 days. In the local firms where industrial ADSMs are the main type of sewing machines for production, the average daily wage is US$ 1.5. The foreign firms –Western owned - however pay an average daily wage of US$ 2. Firms that use WSMs and ADSMs respectively spend an average of US$ 411 and US$ 343 on labour annually per machine (Table 8.6). This represents almost 55 % of the annual cost of operating an industrial WSM and 52 % of an ADSM in the firms studied (see Table 8.2 above). The study observes that the wage cost of labour at the small scale level in urban areas is greater than the large scale firms (see Tables 7.2 as opposed to Table 8.2 above). Therefore on the part of the operators, under the conditions of this study, income distribution at the small scale level is wider than large scale production.

8.3 Comparing the outputs of the industrial ADSMs and WSMs

The study has so far elaborated on the cost structure in garment production at the large scale manufacturing level. In doing so, the study has demonstrated that though the speed of the garment operators is important in determining the level of productivity of a sewing machine regardless of type, there are other factors such as frequent needle breaks that can slow down progress in garment production. I have also demonstrated that the WSMs in the study firms are able to operate faster with the aid of power than the ADSMs. However, in locations where there is no energy infrastructure, the ADSMs are the only option. These findings have implications on the quantity and value of garments that is produced by both technologies.

In Chapter 7 above, the study laid emphasis on the amount of value that is added and the quantity of medium sized "kitenge shirts" that is produced with either type of sewing machine. In addition the study measured the percentage of fabric that is damaged as a result of using either type of sewing machine. The study follows the approach in Section 7. 3 to measure the quantity of garments produce by the industrial sewing machines.

On average, the industrial WSMs and ADSMs, considered at the large scale manufacturing level—through the 11 firms studied—respectively produce 17 and 14 "kitenge shirts" a day. The difference is due to the frequent interruption that the industrial ADSMs experience during sewing (see Chapter 5 above). This further compromises the value added to the garment. Table 8.7 shows that those in the study firms who use the ADSMs and WSMs to sew add US$ 9 and US$ 10 respectively to the garment they produce. In sum, over the course of a year, the value of total garments produced by the ADSM (US$ 23,040) is lower than those of the WSM (US$ 33,771) in the firms studied (Table 8.7).

On the whole and as an average across the 11 firms studied, the percentage of waste that is produced by the ADSMs is three times that of the WSMs (Table 8.7). The waste is mainly due to needle breaks during sewing which eventually tears the fabric and renders the stitches weaker. A supervisor at the sewing department explains that

> *"for a proper output, you need to make sure that the needles don't break....you must always make sure the needle does not break during sewing otherwise it will destroy the fabric".*

Furthermore, assuming both technologies uses the same length of fabric and produces homogeneous output; the ADSMs will produce a lesser quantity of fabric when compared to the industrial WSMs (Table 8.7).

Table 8.7: Level of output and percentage of waste of the two sewing machines per year (unless otherwise specified)

	ADSM	WSM
Annual Length of Fabric used (yards)	10,368	10,368
percentage of Fabric Waste (%/pa)	9	3
Number of Garment produced (pa)	2,688	3,264
Value addition/garment (US$)	9	10
Total Value of Garments (US$)	23,040	33,805

Source: Author's Computation, based on data collected for fieldwork, 2012-2013

8.4 Rate of return of the technologies: industrial ADSMs versus WSMs

Though both the industrial ADSMs and WSMs are economically efficient (based on the figures received from the 11 firms and the resulting calculations reported here), it is important to ascertain which of the two technologies generates higher returns. The study uses the two key discount measures I employed in Chapter 7 to compare the private profitability of the two technologies for the study firms —the Net Present Value (NPV), and Cost Benefit Ratio (CBR). Table 8.8 below shows that investing in industrial WSMs creates more return on investment than the ADSMs. This is shown with a CBR of 1.17 for the industrial WSMs relative to 1.00 for the ADSMs. Furthermore, the NPV for the industrial ADSMs and WSMs is $10,143 and $19,464 respectively. Again, I have seen in Chapter 6 that the distribution of the industrial AD garment making machines is wider than those from the west; but this does not reflect their level of profitability. As previously indicated, this is contrary to the assertion available in the literature that the extent of the distribution of technology must reflect their level of profitability. I discussed in Chapter 2 that there is the need for adequate information about a technology in order for it to be useful (see Sahal, 1981 and 1982). Considering the fact that information about a technology is important in determining the usefulness of the technology, imperfect information on the AD technologies before 2000s might have led adopters to not have the full knowledge about the technology and therefore not be able to use them skilfully to maximise profit. This is coupled with the fact that the quality and quantity of output from the AD technologies can easily be compromised (see Chapters 5, 7 and 8).

Table 8.8: Comparing the private profitability of industrial WSMs and ADSMs

	WSM	ADSM
NPV (US$)	19,464	10,143
CBR	1.17	1.00

Source: Author's Computation, based on data collected for fieldwork, 2012-2013

8.5 Conclusion

This chapter concludes that the private profitability of the industrial WSMs is higher than the ADSMs in large scale garment production based on the data collected from the

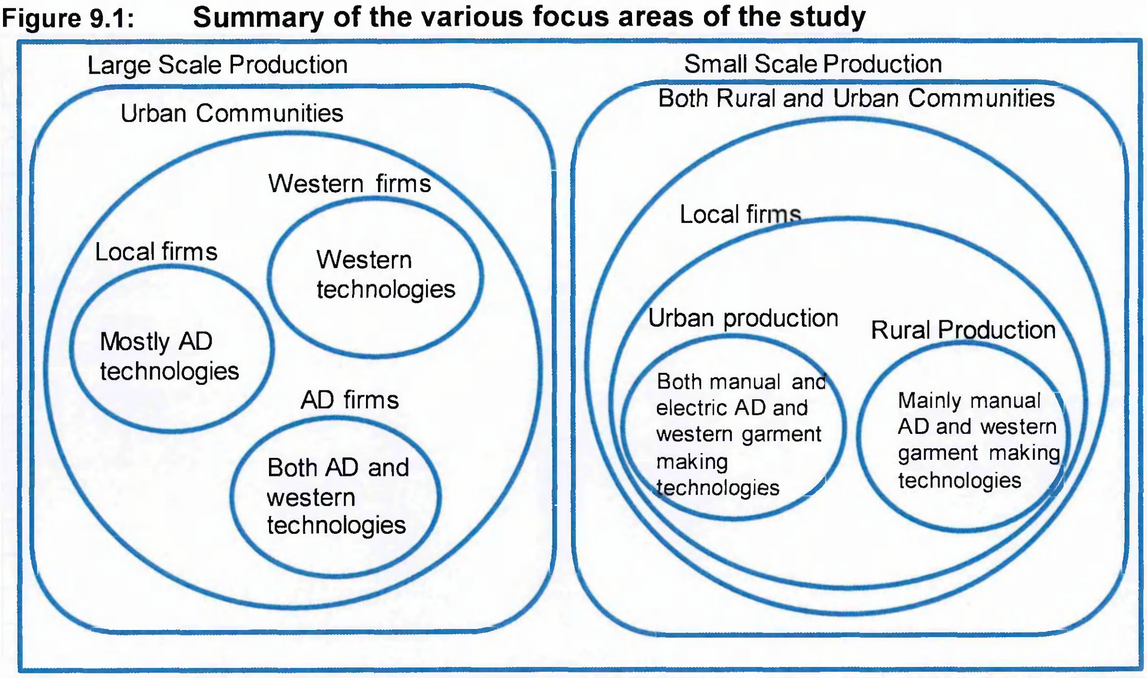
11 firms studied. At the large scale level, the industrial WSMs yield higher returns relative to the industrial ADSMs. It must be emphasised that the less profitable machines are also used for garment production. This is because even though the machines may be less profitable when both fixed and variable costs are taken into account, once they are installed they continue to operate since the entrepreneur has written off the fixed costs. I also conclude that there are knowledge imperfections on the technologies and so investors do not know accurate costs before they purchase them. Finally this chapter concludes that supervisors in the large scale firms train the local machine operators to acquire on-the-job skills and tacit knowledge in garment machine operations. The next chapter discusses how garment making machines can be used to achieve some key policy objectives in Uganda.

CHAPTER 9: APPROPRIATENESS SCENARIOS AND THEIR RELEVANCE TO POLICY IN UGANDA

9.0 Introduction

Chapters 5 to 8 have so far focused on technologies at the small and large scale levels of garment production (Figure 9.1). Large scale garment production firms are based in urban areas because of the presence of energy infrastructure for large scale garment production. There are local, AD and Western investors who are involved in large scale garment production in Uganda (Figure 9.1). The local firms mostly use industrial AD technologies. The Western firms on the other hand use mainly Western technologies. However the large scale AD firms use technologies from both sources (i.e. AD and Western economies) for the production of garments (Figure 9.1).

Figure 9.1: Summary of the various focus areas of the study



Source: Base on the Author's fieldwork, 2012-2013

Unlike the large scale producers, the small scale garment firms are mainly locally owned and are based in both urban and rural areas (Figure 9.1). Production of garments at this level involves both manual and electric driven technologies (Figure 9.1). The ADSMs are more widely distributed in both locations than the WSMs.

This chapter uses scenarios to show how investments in garment making technologies can contribute to growth in the manufacturing sector. The growth in the sector will contribute to the absorption of excess labour in the agriculture sector (as recommended by the National Development Plan of Uganda 2010/11-2014/15). In doing so, this chapter focuses on three key policy documents in Uganda—the National Development Plan of Uganda 2010/11-2014/15, the National Industrial Policy of Uganda, and the National Textile Policy of Uganda.

The National Development Plan of Uganda 2010/11-2014/15 identifies the use of low and inefficient technology, obsolete machinery, equipment and tools as a cause of the slow growth in the manufacturing sector in Uganda (GoU, 2010). In order to solve this issue, the document recommends the provision of appropriate capital equipment for the establishment of enterprise start-up business clinics for job creation.

The Uganda National Textile Policy document also recommends investments in new labour intensive simple technologies that can be used by unskilled labour for garment manufacturing (GoU, 2009). The policy also aims at the creation of a dynamic apparel manufacturing sector that has the capacity to transform produced fabric into garments of acceptable cost and quality for domestic, regional and international markets (GoU, 2009). In doing so, the policy proposes investment in infrastructure to create an enabling environment for a faster transfer and wider distribution of garment making machines to local garment producers for the production of uniforms. Furthermore, the policy aims at training resource personnel on how to use the different types of garment making technologies for onward skills transfer (GoU, 2009).

A summary of the key policy actions[17] in the National Industrial policy of Uganda is detailed in Section 4.2.3. The document focuses on transforming the industrial sector through infrastructure development, technology transfer, as well as the development of

[17] This is a summary of the detailed policy action in Section 4.1.2.

skills required to identify, maintain and repair the most appropriate technology for the sectors.

Four expected policy outcomes resonate across these three policy documents—employment creation, increased output, investment in technology and infrastructure development. The Uganda National Household Survey 2009/10 indicates that on average, every household member in Uganda uses an average of two garments per year. In this chapter I consider what it would take to achieve the above policy outcomes of providing 2 garments per capita in Uganda. In other words, with a total population of 36.35 million, what would it take the firms in Uganda to produce a total of 73 million garments to meet the country's annual demand? The Ugandan National Textile Policy proposes an annual investment of US$ 10 million for the acquisition of garment making equipment for this programme (GoU, 2009). In this chapter, I assume the fixed capital (US$ 10 million) is used for the acquisition of either ADSM or WSM equipment. I use the annual quantity of garments required and the proposed annual capital investment to explore the implications of meeting these multiple policy objectives in such a capital constrained economy using two alternative scenarios. The two scenarios are:

1. Fixed capital constraints—invest an annual capital of US$ 10 million for the acquisition of either ADSMs or WSMs. This scenario is meant to reflect a world of capital scarcity in Uganda.

2. The production of 73 million "kitenge shirts" annually. This shows the consequences of policies designed to enhance consumption by the poor.

For the purposes of easier comparison of the ADSMs and WSMs, the following assumptions (unless otherwise specified) are made:

1. Products of the ADSMs and WSMs are homogeneous.

2. All machines are purchased new and have a life span of 10 years with no scrap value.

3. All the products that are produced in a given period are sold.

4. The small scale firms employ an average of 10 workers and those of large scale firms employ not less than 50 workers (this is supposed to reflect the actual size distribution observed in Chapter 6).

9.1 Social appropriateness of the two alternative small scale technologies

9.1.1 Investing an annual capital of US$ 10 million

There are two alternative decisions to make with a fixed capital investment of US$ 10 million in sewing machines at the small scale level.

1. To invest in less capital intensive ADSMs in order to get more of them for job creation but at the cost of frequent breakdowns of the machines and producing lower quality garments.

or

2. To invest in durable but capital intensive WSMs to ensure quality output and less breakdowns.

Relative to the electric sewing machines, more sewing machines will be procured if the investment is made in only manual sewing machines. With the given fixed capital, either 28,000 manual ADSMs or 17,500 manual WSMs will be procured (Table 9.1). This also implies that a total of 28,000 jobs will be created with the manual ADSMs if I consider the fact that each sewing machine requires one operator. The manual WSMs on the other hand will result in the creation of 17,500 jobs.

Similarly, an average of 15,556 sewing machines will be procured if all the fixed capital is invested in electric ADSMs (Table 9.1). This is 30 % more than the number of electric WSMs (10,769) that can be procured with the same amount of capital (Table 9.1). This also implies that more jobs will be created with the electric ADSMs compared to the electric WSMs. Similarly, investing all the US$ 10 million in electric ADSMs will lead to the creation of more firms compared to the electric WSMs. 1,556 firms will be created if the investment is made in only ADSMs (Table 9.1). This number will be 30 % lower if the investment is made in only electric WSMs. Likewise, there will be more firms if all the investment is made in manual ADSMs (2,880 firms) rather than the manual WSMs (1,750 firms). In terms of output, the electric ADSMs are superior despite the fact that they create fewer jobs compared to manual ADSMs. But investment in energy infrastructure will be crucial for the electric ADSMs. Thus, it will be easier to use the manual ADSMs to meet the national demand (as described in the National Textiles Policy document) than the other categories of machine considered.

Table 9.1: Appropriateness of the ADSM and WSM with a US$ 10 million fixed capital investment

	Urban (Electric)		Rural (Manual)	
	ADSM	**WSM**	**ADSM**	**WSM**
No. of Sewing Machines	15,556	10,769	28,000	17,500
No. of Jobs per year	15,556	10,769	28,000	17,500
No. of "kitenge shirts" per year (000)	32,356	28000	29,120	13,650
Number of Firms	1,556	1,077	2,800	1,750

Source: Base on author's assumptions and field data, 2012-2013

Note that a medium size "kitenge shirt" will require 3 yards of fabric and the cost of each fabric is US$ 2.32

9.1.2 Social outcomes for producing 73 million "kitenge shirts" annually

The investment cost for using only electric ADSMs for the production of 73 million "kitenge shirts" is lower (US$ 22.56 million) than using only electric WSMs (US$ 26.07 million). This investment will create more jobs and firms if only electric ADSMs are procured. The number of jobs and firms that will be created with the WSMs will be lower if the WSMs are used for the production. If one considers the fact that an electric ADSM produces an average of eight "kitenge shirts" a day (see Section 7.3), then 35,096 of them will be required to produce the total 73 million "kitenge shirts". This number is more than the jobs that will be created out of the 73 million "kitenge shirts" when the investment is made in only electric WSMs (28,077 jobs).

Table 9.2: Appropriateness of the ADSM and WSM with the aim of producing 73 million "kitenge shirts"

	Urban (Electric)		Rural (Manual)	
	ADSM	**WSM**	**ADSM**	**WSM**
Total Number of Machines required	35,096	28,077	70,192	93,590
Capital Cost (US$ Millions)	22.56	26.07	25.07	53.48
Ave. No of jobs per year	35,096	28,077	70,192	93,590
Number of Firms created	3510	2808	7019	9359

Source: Base on author's assumptions and field data, 2012-2013

Paradoxically, there will be more firms and jobs created with the manual WSMs in rural areas than the manual ADSMs because the former are less productive in rural areas. Investing in the manual WSMs will lead to the establishment of 9,359 small scale enterprises in rural areas. This will subsequently lead to the creation of 93,590 jobs. However, this will be traded off with higher capital cost (Table 9.2). It will require a US$ 53.48 million investment in manual WSMs to produce the 73 million "kitenge shirts". Hence, it may not be advisable to procure manual WSMs to produce the required 73 million "kitenge shirts" for the country. However, investment in only manual ADSMs will only require 50 % less (US$ 25.07 million) of that of the manual WSMs to produce the 73 million "kitenge shirts". In addition, it will lead to the establishment of 7,019 enterprises. This will translate into the creation of 70,192 jobs for the economy.

In both cases (rural and urban) the manual ADSMs appears to be employing more labour and creating more jobs than the other technologies. Though each electric sewing machine produces more garments than the manual ones, there are costs in using them to create jobs and establish enterprises in Uganda. In addition to the fact that they are relatively capital intensive, the electric sewing machines also require energy infrastructure to operate. I will also consider cost implications of energy requirement for the two sewing machines in a later section of this chapter. Thus, manual ADSMs will be more appropriate for achieving the objective of moving the excess labour force from the agriculture sector to the manufacturing sector (as prescribed by the Uganda National Development Plan 2010/11-2014/15).

At the small scale garment production level the manual ADSMs can contribute significantly in achieving the Uganda National Textiles Policy's objective of achieving a nationwide distribution of garment technologies. The policy also aims at a comprehensive National School Uniforms Decentralised Garmenting Programme necessary for kick-starting nation-wide garment production. The key attributes of the manual ADSMs as indicated earlier make them more suitable for achieving these objectives. The demerit is that they breakdown more frequently and may require more repairers for their repairs. Later in this chapter, I will discuss in detail the skills requirement for repairing these machines.

9.2 Nexus between distribution and surplus of the ADSMs and WSMs at the small scale level

I use the profitability figures in Chapter 7 and 8 (see Tables 7.2 and 8.2 above) and the estimated distribution figures in Tables 9.1 and 9.2 to analyse the relationship between distribution and profitability at the macro level. In general, the distribution of the sewing machines does not entirely reflect their profitability figures. For instance, a US$ 10 million investment in only electric WSMs will yield an average annual surplus of US$ 1.33 million. However, the annual surplus accrued as a result of investing in only manual ADSMs is US$ 1.23 million (Table 9.3). As indicated above, more of the electric ADSMs can be acquired with the given capital US$ 10 million when compared with the electric WSMs. The same pattern is observed when it comes to meeting the 73 million annual garment demands in Uganda.

The story is different when it comes to manual sewing machines. Investing all the US$ 10 million in only manual ADSMs will yield higher surplus than the manual WSMs (Tables 9.3 below). Similarly, producing 73 million garments with electric WSMs will accrue more surplus than the electric ADSMs. Surplus from the manual ADSMs is higher than that of the manual WSMs (Tables 9.3). Therefore Uganda, as a country with 85 % of its population living in rural communities (GoU, 2012) stands a better chance of creating more jobs and small scale enterprises with the manual ADSMs based on the data received and analysed during this study. Furthermore, energy requirements will not be an issue since the manual ADSMs requires no energy to operate.

Table 9.3: Distribution and surplus generated by the ADSMs and WSMs

Investing in sewing machines with a fixed capital of US$ 10 million	Urban (Electric)		Rural (Manual)	
	ADSM	**WSM**	**ADSM**	**WSM**
***Investing US$ 10 million in** SMs**				
No. of Sewing Machines	15,556	11,769	28,000	17,500
Surplus (US$ million per year)	1.23	1.33	1.14	0.35
***Producing 73 million** "kitenge shirts" per annum*				
No. of Sewing Machines	35,096	28,077	70,192	93,590
Surplus (US$ million per year)	2.78	3.17	2.86	1.87

Source: Base on author's assumptions and field data, 2012-2013   ** sewing machines*

9.3 Scenario appropriateness at the large scale level

I repeat the scenarios that were undertaken at the small scale level at the large scale level in this section. Unlike the small scale level, I will concentrate only on industrial (electric) machines at this level. This is because the large scale garment producers use mainly electric sewing machines for production (see Chapter 8).

9.3.1 Investing US$ 10 million in industrial sewing machines

Similar to the small scale analysis, more sewing machines will be realised if the investment is made in only industrial ADSMs. On average, 9,333 sewing machines will be realised if the investment is made in only industrial ADSMs. This will translate into the production of 25 million "kitenge shirts" annually. Furthermore, the investment will lead to the creation of 9,333 jobs annually with the industrial ADSMs (Table 9.4). Conversely, only half the number of jobs will be created if the same amount of investment is made in only industrial WSMs. Assuming also that each large scale firm employs an average of 10 workers, an investment of US$ 10 million in industrial ADSMs will yield a total of 933 enterprises. Instead, only 509 new enterprises will be created if the investment is made in only industrial WSMs (Table 9.4). Furthermore, the industrial ADSMs create almost twice the total number of jobs that the industrial WSMs can create.

Table 9.4: Appropriateness of the two alternative industrial machines when there is a US$ 10 million investment

	ADSM	WSM
Assume an annual fixed capital of US$ 10 million		
No of Sewing Machines	9,333	5,091
Number of firms	933	509
No. of Jobs created	9,333	5,091
No. of total "kitenge shirts" per year (000)	25,088	16,617
Surplus generated per year (US$ 000)	960	990

Source: Author's fieldwork, 2012-2013

9.3.2 Production of 73 million "kitenge shirts" per annum at the large scale level

Relative to the industrial WSMs, more industrial ADSMs will be required to produce the annual 73 million "kitenge shirts". In addition, investing in industrial ADSMs will led to the creation of 2,006 enterprises (Table 9.5). This will translate into the creation of 20,055 jobs (Table 9.5). The number created will be lower if emphasis is laid on only industrial WSMs (16,516 jobs) (Table 9.5). Producing 73 million "kitenge shirts" with industrial WSMs will lead to the creation of fewer numbers of enterprises (1,652 enterprises) than if industrial ADSMs were the focus. Coupled with the fact that they create fewer jobs and enterprises, the required capital cost for the industrial WSMs (US$ 32.44 million) is 33 % higher than those of the ADSMs (US$ 21.45 million) (Table 9.5). As indicated in Chapter 8 above, the industrial WSMs produce more quality garments compared to the industrial ADSMs.

Table 9.5: Appropriateness of the two alternative industrial machines when producing 73 million "kitenge shirts"

Assume annual production of 73 million "kitenge shirts"	ADSM	WSM
Total number of machines	20,055	16,516
Amount of Capital Required (US$ millions)	21.45	32.44
No of People employed per year	20,055	16,516
Number of Firms	2,006	1,652
Surplus Generated per year (US$ millions)	2.06	3.23

Source: Author's fieldwork, 2012-2013

9.4 Nexus between distribution and surplus of the ADSMs and WSMs at the large scale level

The surplus generated as a result of using an industrial ADSM is relatively lower than the industrial WSMs despite the fact that the number of industrial ADSMs is more than those of the WSMs. This is the case for both scenarios. With a total of 9,333 industrial ADSMs, a total surplus of US$ 946 thousand per annum will be realised (Table 9.6). This is less than the US$ 993 thousand that is generated by the 5091 industrial WSMs (Table 9.6). Similarly, meeting the country's demand for 73 million "kitenge shirts" will require a total of 20,055 industrial ADSMs. This will result in a total surplus of US$ 204,000 for the industrial ADSM annually (Table 9.6). However more surpluses are generated with fewer numbers of industrial WSMs.

Table 9.6: Distribution and surplus of the two industrial sewing machines

	ADSM	WSM
Assume a fixed capital of US$ 10 Million		
Total number of Sewing Machines	9,333	5,091
Surplus Generated (US$ 000/pa)	946	993
Assume annual production of 73 million "kitenge shirts"		
Total number of machines	20,055	16,516
Surplus Generated (US$ millions/pa)	0.204	3.21

Source: Author's fieldwork, 2012-2013

The issue with the industrial technologies is that they create fewer jobs and enterprises than investing in the small scale sewing machines. Relative to the small scale sewing machines, the US$ 10 million investment capital proposed in the GoU (2009) National Textile Policy may not lead to a wider spread of the sewing machines across the country. This also means that achieving the two garments per capita will be challenging if all the investment is made in industrial sewing machines. However, in terms of more surplus generation, the industrial WSMs may be the most appropriate for this programme.

9.5 Skills requirements for repair works on the machines

As indicated in Chapters 7 and 8, the rate of breakdown of the sewing machines is important in the determination of the output and profitability of the garment making technology. In this section, I examine the possible skills requirement for operating and repairing the two types of machine. This will be done in the context of the two scenarios discussed above.

9.5.1 Skills requirements at the small scale level

Chapter 7 indicates that the ADSMs break more frequently (twice a year) than the WSMs (once every 2 years). This means each ADSM will report two different cases per year. In total operators of ADSMs are expected to report an average of 31,112 repair cases to the government if all the ADSMs breakdown twice each year (Table 9.7). This number is 5 times more than that of the WSMs (Table 9.7). As described in Chapter 7 above, each repair firm is capable of repairing three ADSMs and one WSM daily. I also establish in Chapter 5 that each repair firm employs an average of five workers. This number also includes apprentices. This means that a total of 199 repairers will be required if the given fixed capital (US$ 10 million) is invested in only electric ADSMs. The number will be fewer if the investment is made in only electric WSMs (113 repairers) (Table 9.7). A greater number of skills in repair works will be required if investment is made in only manual ADSMs. 538 skilled repairers will be required if the investment is made in only manual ADSMs (Table 9.7). Furthermore, based on the assumption that each repair firm has an average of five workers, these findings suggest that encouraging the use of only electric ADSMs could potentially create 40 firms as opposed to only 23 firms if electric WSMs are promoted. The largest number of repair firms (108 - again based on each firm having an average of five employees) will be realised if only manual ADSMs are promoted for use in rural areas (Table 9.7).

Table 9.7: Investing in sewing machines with a fixed capital of US$ 10 million

	Urban (Electric)		Rural (Manual)	
	ADSM	WSM	ADSM	WSM
Total number of Sewing Machines	15,556	11,769	28,000	17,500
Number of repair cases per year	31,112	5,885	8,4000	17,500
Number of Repair Firms Created	40	23	108	67
Number of Repairers	199	113	538	337

Source: Author's assumptions and fieldwork (2012-2013)

In the case of producing the total required "kitenge shirts" (73,000) per annum, this would require procuring 70,192 manual ADSMs which would require a total of 1,350 skilled repairers to repair and maintain them in case they breakdown (Table 9.8). This also means that 270 repair firms would be established (Table 9.8). The number of repairers and firms will be the highest for the WSMs but as indicated earlier, the less productive nature of the manual WSMs may make it not advisable to invest in them. In the case of the electric sewing machines, investing in only ADSMs will require an average of 90 firms and 450 skilled repairers (Table 9.8).

Table 9.8: Skills requirement for producing 73 million "kitenge shirts" per annum

	Urban (Electric)		Rural (Manual)	
	ADSM	WSM	ADSM	WSM
No. of Sewing Machines	35,096	28,077	70,192	93,590
Number of repair cases per year	70,192	14,039	210,576	93,590
Number of Repair Firms Created	90	54	270	360
Number of Repairers	450	270	1350	1800

Source: Author's assumptions and fieldwork (2012-2013)

9.5.2 Skills requirements at the large scale level

At the large scale level, 18,666 repair cases will be recorded for the ADSMs if all of them (9,333 ADSMs) break down twice each year (Table 9.9). Nevertheless, the WSMs will record a lesser number of repair cases (2,546 cases) if all of them (5,091 WSMs) break down once in every two years (Table 9.9). On average, a repair firm can repair an average of 3 industrial ADSMs a day (Chapter 8). In the case of industrial WSMs, a repair firm is capable of repairing 1 daily (see Chapter 8 above). Therefore, an average of 120 sewing machine repairers will be required if only ADSMs are required with the total fixed capital (US$ 10 million) at the large scale level. This will lead to the creation of 24 firms if each firm will require five employees. However, it will only require 49 repairers in the case of the WSMs and this will lead to the creation of 10 firms if each firm employs five workers (Table 9.9).

Table 9.9: Annual skills requirement for large scale machine repairs

	ADSM	WSM
Proposed US$ 10 million investment		
Total number of Sewing Machines	9,333	5,091
Number of cases per year	18,666	2,546
Number of Repair Firms Created	24	10
Number of Repairers	120	49

Source: Author's fieldwork, 2012-2013 and assumptions

Producing 73 million garments with 20,055 industrial ADSMs will lead to a total number of 40,110 reported repair cases if all the machines breakdown within a year (Table 9.10). This will translate into the establishment of 51 enterprises and will require 257 repairers for this activity (Table 9.10). In the case of the industrial WSMs, only 8,258 reported cases will be realised if all of them break down within a year (Table 9.10). This means that 159 repairers will be required and will lead to the establishment of 32 repair firms.

Table 9.10: Production of 73 million "kitenge shirts"

	ADSM	WSM
Total number of Sewing Machines	20,055	16,516
Number of cases per year	40110	8258
Number of Repair firms created per year	51	32
Number of repairers per year	257	159

Source: Author's fieldwork, 2012-2013 and assumptions

The frequent repairs of the ADSMs may result in the creation of more sustainable jobs than the WSMs. The demerit is that extra cost may be incurred to train repairers for the frequent breakdown of the ADSMs. Therefore in the context of the skills requirement for repair works, the AD technologies appear to be more skills intensive. This deviates from the state of the art that argues that technologies from developing countries are simple to use and are less skills intensive (Kaplinsky, 2010, Bhalla, 1985 and Stewart, 1982).

Also as indicated above, the AD economies serve as a source of cheap soft technology. Therefore, relying on soft technology in the form of repair skills and tacit knowledge on the garment making machines will be very important for garment production at the national level.

9.6 The potential for learning and innovation

This study is focused on the role of hard and soft technologies and their role in enhancing the productivity of the garment sector in Uganda. Specifically, set out to investigate the assumption that AD originating hard and soft technologies are more suited to the Ugandan environment and in so doing lead to more inclusive innovation in the garment sector. As outlined in Chapter 2, Clark *et al.* (2009) hypothesise that the rise of the AD economies has the potential to develop a new generation in innovation systems, with the core objective of developing low-cost products and processes for low-income economies. This chapter has highlighted how ADSMs are indeed a potentially disruptive innovation – a way of creating a higher number of jobs and therefore potentially sustainable livelihoods than WSMs – as per the discussion in Section 2.1.3. However, the innovations that are important are not just the physical hard technologies. Key to successful introduction and continued use of these are the soft technologies that must also go alongside this. This chapter and chapter 5-8 have highlighted the importance of skills and tacit knowledge transfer in ensuring successful use of ADSMs (and WSMs) in the garment making sector in Uganda. This backs up the arguments outlined in Chapter 2 that successful hard technology transfer is only possible when there is similar soft technology or knowledge transfers too.

The Ugandan garment sector stands to increase productivity by learning from the AD expatriate expertise. The will require the acquisition of competence and skills that allow the local garment producers to be more successful in reaching their individual goals or those of his/her organisation (Lundvall and Johnson, 1994). For instance, the local garment producers can learn modern managerial, organisational and technological competence from the AD economies. In addition, the presence of the ADs in the Ugandan garment sector can serve as a window for garment producers to inculcate innovation in their production activities so as to increase productivity. In the long term, Uganda can learn from the AD economies on how to locally innovate technologies that can increase productivity in the sector.

9.7 Conclusion

This chapter focuses on the economic impact of using AD and Western technologies based on the data received during fieldwork. Similar to Chapters 7 and 8, this chapter uses the sewing machine as a case study. In general, the chapter shows that manual ADSMs have the potential to create more jobs and have better income distribution attributes than the WSMs, though the former produces less quantity of garments.

That said, the wider spread of the ADSMs does not entirely reflect the profitability levels of the machine. This chapter as well as Chapters 7 and 8 have shown that garment producers may be able to easily access an AD garment making machine because it is cheaper to acquire. However, it is unable to produce quality garments and therefore does not add much value to the garments produced compared to the Western originated machines. This leads to marginal profit levels compared to the Western machines.

The study also shows that the AD technologies can be skills intensive and therefore has extra cost implications for skills development. Specifically, the importance of tacit knowledge on the garment making machines cannot be ignored in garment production at the national level. This is important because successful innovation cannot take place simply with hard technology transfer. Allied to this needs to be soft technology transfer or skills accumulation. The policy recommendations resulting from such findings and others will be outlined in Chapter 10 below.

CHAPTER 10: CONCLUSION AND POLICY IMPLICATIONS

10.0 Introduction

This thesis is posited on the recognition that developing countries over the years have been facing growing difficulties in accessing technologies which are suitable to their operating environments as a consequence of relying on Western technologies. This is because technologies from the Western economies tend to be capital, skills and scale intensive, operate in environments with reliable infrastructure, and produce products for high income earners. However, it is hypothesised that the growing global shift of technological capabilities from the Western economies to the AD economies is likely to benefit consumers in developing countries (Kaplinsky, 2010). This is based on the fact that the AD economies have been able to develop their capacity in technological development in a relatively weaker infrastructural environment with lower wages compared to those from the Western economies; creating technologies that are more suited to the needs and demands of other developing economies. Based on these facts the study also took as its starting point the connected assumption that, as a result, the AD economies are likely to become the dominant source of technological innovation for low income consumers in other developing countries where such conditions also exist (Chapters 1 and 2). Technologies developed in the AD economies and transferred to other developing countries are therefore assumed to be labour intensive, tolerant to weak infrastructure, low cost, operate on small scale basis, and less skills intensive (Clark *et al.* 2009 and Kaplinsky, 2010). But these are largely untested assumptions.

In order to validate these assumptions or otherwise, the study examined the distinctiveness and profitability of the AD and Western garment making machines in Uganda. I built my conceptual framework for this thesis around five key sets of literature that can be used to understand this current situation—the concept of hard and soft technology, technical choice, appropriate technology, technical change, technology transfer and the rise of the AD economies. As will be discussed in Section 10.3 of this chapter, I identified key research gaps in the field which led me to ask the following four research questions:

1. How is garment equipment from the AD and Western economies transferred to Uganda?
2. Does the level of distribution of the AD garment equipment differ from those of the Western ones in Uganda?
3. How distinctive are AD and Western garment equipment in developing countries?
4. Does the degree of profitability of the AD garment equipment differ from those from the Western economies?

As described in Chapters 1 and 3, I answered the above questions by focussing on garment making machines in urban and rural areas in Uganda. Uganda was considered because of its unique situation as a landlocked country with one of the fastest population growth rates in the world. This is coupled with rising inequality and unemployment, largely caused by the lack of technological progress in a weak infrastructural environment. I considered industrial and small scale garment making machines at the large and small scale levels of garment production respectively. Garment making machines were considered because of their job creation and income distribution attributes and because they produce consumer goods for low income consumers.

The chapter is organised into 7 sections. Section 10.1 briefly summarises the study. Section 10.2 recapitulates the definition of the ADs and also provides a description of the role of the AD economies as a source of garment making technologies for Uganda. Section 10.3 provides an overview of the findings in relation to each of my research questions. Section 10.4 analyses the findings and conclusions in relationship to the theories underpinning the research and discussions on how they contributed to the academic debates in relation to technology, technological change and choice and technology transfer as well as debates around appropriate technology. Section 10.5 discusses the policy implication of these findings. Section 10.6 discusses limitations of the study, and Section 10.7 presents suggestions for future research.

10.1 Brief summary of the findings

Following the theories and the research questions above, the study used the data collected on the garment making machines in Uganda to confirm the underlying assumption that is drawn from the literature that the AD economies are becoming the dominant sources of technologies being utilised in developing countries. In the case of this study, it was found to be due to a wider spread and growing demand of AD garment making machines relative to Western ones in Uganda. The study also validated the assumption that technologies from the AD economies to developing countries like Uganda are tolerant to weak infrastructure, low cost, and easier to access. Contrary to my expectation I found that the AD garment making machines are skills intensive because they are less robust. Evidence from the study showed that the frequent breakdown of the AD technologies calls for training of repairers and requires skills in operation to reduce the chances of needle breakages. The study also confirmed the assumption that the spread of the AD garment making machines is contributing to inequality reduction among its users.

10.2 The role of the AD economies as a source of hard and soft garment making technologies

As indicated in Chapter 2, this study is specifically focused on AD technology—technology that comes from either India or China; two of the dominant AD economies. In addition, the study refers to AD actors who bring skills and investment to Uganda. These AD actors do not include the Asian origin long-term Ugandan residents (most of whom are Ugandan citizens). This is because the Asian long-term Ugandan residents played no role in the rise of the AD economies. They are also not sources of technologies for developing countries. However, this study underscores the fact that the long-term Ugandan-Asians also play an important role in the transfer of technology from AD sources into Uganda.

Based on the hypothesis that the AD economies of China and India are likely to become major sources of hard and soft technologies to developing countries (see Chapters 2 and 3), I provided a 2 x 2 matrix in Table 2.2 (Chapter 2) above to draw together these relevant elements for analysing the AD economies (China and India) as a source of hard and soft garment technology for Uganda. I now populate the 2 x 2 matrix table in this section based on my findings outlined in Chapters 5 to 9. Table 10.1 below presents the populated 2 x 2 matrix that shows the role of each Asian Driver country as a source of garment making technologies. I shall now discuss each segment of the table in a little more depth in Section 10.2.1, 10.2.2, and 10.2.3. This is done in the context of the three channels of interaction that I discussed in Chapters 2 and 6—trade, FDI and cross border movement of personnel. I draw my conclusions on the role of each country as a source of garment making technologies in the context of their channel of interaction. As I discussed in Chapter 2, I consider technology in two forms – "hard" embodied technologies, and "soft" disembodied technologies.

10.2.1 China as a source of garment making technologies for Uganda

This section elaborates on the role of China as a source of garment making technologies into Uganda. I draw my conclusions by considering the channel of interaction of the garment making machine—Trade, FDI and cross border movement of personnel.

Table 10.1: Framework for analysing Asian Drivers as a source of technology

AD Country	Channel of interaction	Hard Technology	Soft Technology
China	Trade	A Growing imports of low cost garment making technologies into Uganda, especially sewing machines.	G
	FDI	B Growing presence of Chinese investment in the garment sector in Uganda through the development and running of factories.	H
	Cross border movement of personnel	C	I Garment making machine experts from China are hired on temporary basis to install garment machines for the local large scale firms.
India	Trade	D Indian firms play a very significant role in the transfer of hard garment technology into Uganda.	J
	FDI	E Growing presence of Indian investments in the form of new factories.	K Indian firms investing in Uganda provide skills, managerial, and technological competence training to the local garment producers.
	Cross border movement of personnel	F	L Garment technology experts from India are employed by indigenous Ugandan large scale firms to install and temporarily maintain sophisticated large scale garment making machines

Source: Author's compilation

China as a source of hard garment making technologies through the trade channel

The conclusion I draw in Table 10.1 above is that China is serving as a source of hard technologies for Uganda. As I indicated in Chapter 4 above, imports of hard garment making technologies from China into Uganda have surpassed that of European Union and Japan—Uganda's traditional importation source. Chapter 6 also provides evidence to show that the distribution of Chinese made garment making machines is wider in terms of geographical reach than those from the Western economies. As I indicated in Chapter 6, the pervasive nature of the Chinese garment making machines is as a result of their low cost nature. I will draw a more detailed conclusion on this later in Section 10.3.2 below.

China as a source of hard garment making machines through the FDI channel

China cannot be ignored when it comes to investments in the garment sector in Uganda hence the statement in Table 10.1 in segment B. Investment from China into the Ugandan garment sector is on the rise. Between 2009 and 2012, 14 firms from China registered with the Ugandan Investment Authority (UIA) with interests in the garment making sector—representing the largest group of foreign firms that have invested in the Ugandan garment sector (Section 6.3.1). These Chinese firms end up investing in Chinese made hard garment making technologies in Uganda.

China as a source of soft technology through cross border movement of personnel

In Segment I of Table 10.1 above, I discuss how Chinese garment experts serve as a source of soft technologies for Uganda. Chinese garment experts are hired by local firms to undertake installation and maintenance activities on their garment making machines. This is usually on a temporary basis. Through this, the Chinese experts train local machine operators and other managerial staff in the indigenous Ugandan owned large scale garment making firms. This enables local employees in the garment firms to acquire the skills and knowledge required to efficiently manage a garment making technology.

10.2.2 India as a source of garment making technologies in Uganda

The findings of this study conclude that India is playing, and is likely to continue to play an even bigger role in the garment sector of Uganda than its AD counterpart of China predominantly supplying soft technology through FDI and cross border movement of personnel and partly through trade.

India facilitating the transfer of garments making technologies from their country of origin into Uganda

The Indians (excluding Ugandan Asians) who are importers and distributors of garment making machines in Uganda play an important role in the transport of garment making machines into Uganda (Segment D). They have haulage trucks that enable them to quickly transport and deliver the garment making machines from the transit point to their clients in Uganda. They ensure on-time delivery.

FDI as a channel of sourcing garment making technologies from India

Indian AD firms investing in Uganda invest in the importation of hard technologies into the country (see Segment E on Table 10.1 above). I further conclude that India as an AD economy serve as a source of soft technologies through FDI (see Table 10.1 above, segments E and K). They transfer the expertise in managing the garment technologies to the local machine operators through on-the-job training activities (see Segment K on Table 10.1 above). These training activities build local garment producers' tacit knowledge, managerial and technological competence (see Case study 2 above in Section 6.3.1). Due to poor remuneration, labour turnover rate in the Indian AD firms is high (see Section 6.3.1). This leads to spillovers of the tacit knowledge, managerial and technological competence (i.e. soft technologies) from the Indian AD firms to the local garment industry.

Cross border movement of personnel as a channel of soft technology transfer from India to Uganda

Table 10.1 (Segment L) summarises this study's conclusion with regard to the role of Indian AD economies in the transfer of soft technologies through cross border movement of personnel. As I indicated in Chapter 6 above, the indigenous local large scale garment producers rely on the Indian AD originating expertise to install their garment making technologies. After the installation, these Indian AD actors train the local machine operators on how to operate and maintain the hard technologies once these Indian operators return to India. Thus, the Indian AD actors serve as a source of cheap soft technology for Ugandan businesses.

10.2.3 The complexity of AD economies and local actor interactions

I have so far shown the role of the AD Indians in the provision of hard and soft technology. Though this study does not factor into the discussion the role of the long term Ugandan Asians, I acknowledge that they also play a role in the transfer of soft and hard technologies in the garment sector. The study has also concluded that China is the main source of hard technologies for the garment sector in Uganda. In addition, evidence from the Ugandan Investment Authority indicates that there are more Chinese garment firms investing in the Ugandan garment sector than those from India and Western economies. However, I found the AD Indian firms enjoy much stronger ties with the local firms compared to the Chinese and Western firms. They do this by providing tacit knowledge, managerial and technological competence to local garment producers in Uganda. Based on these conclusions regarding the role of the AD economies in provision of hard and soft garment technologies in Uganda, I now relate these back to my original research questions that I posed in Chapters 1 and 3.

10.3 Research findings

This section presents the findings on each research question and their relevance to theory. I first recap the rationale for the question in relation to the gaps in existing literature and then proceed to discuss my findings. This is followed by a discussion on how my findings can be used to fill the gaps identified.

10.3.1 Conclusions from the findings relating to research question one

How is garment equipment from the AD economies and Western economies transferred to Uganda?

As indicated in Section 1.3, the first question this study set to answer focused on the modes of transfer of garment making machines into Uganda. This was the focus predominately on research discussed in Chapter 6 through an analysis on how garment making machines are transferred into the garment sector in Uganda. I drew on the literature on technology transfer to analyse the mechanism of transfer of the garment making machines from the AD and Western economies into Uganda. More importantly, the answers to the above question were used to fill the gaps that were identified in the theory of technology transfer literature.

Gaps in the existing technology transfer literature

Evidence available in literature identifies transport cost as one of the main challenges inhibiting technology transfer to a landlocked country (Faye, *et al.* 2004, and UNCTAD 2013). Yet, the cost of transferring a technology to Uganda as a landlocked country has not received much attention in the technology transfer literature. Furthermore, the role of the AD economies in technology transfer to the garment sector in Uganda is scanty in the literature. Most of the studies focus on technology transfer from the Western economies to developing countries (Maskus, 2004, and Bozeman, 2000). More importantly, the benefits of FDI from the AD economies to developing countries have mainly focused on primary commodities and infrastructural development (Brautigam, 2009 and Dent 2011), but not as a means of technology transfer to the manufacturing sector in Uganda. This study fills these gaps by showing that the AD economies play an important role in the transfer of hard and soft technologies into Uganda. For instance as indicated above, they have the capacity to make on-time delivery of hard technologies into Uganda. In addition, they provide soft technology in the form of tacit knowledge, technological and managerial skills for the indigenous Ugandans. More importantly, this study has shown that it is not only the Western economies but also the AD economies that serve as sources of garment making technologies for developing countries like Uganda. In order to fill these gaps, issues such as cost and duration of transfer, transport infrastructure as well as the role of the AD economies in the transfer of soft and hard technologies were considered in the analysis.

Findings on the mode of transfer at the small scale level of garment production

The most important mode of technology transfer at the small scale level of garment production in Uganda is direct import and marketing. My findings show that transferring garment making machines through direct imports and marketing is mainly by air and sea (and then road). I also found that the cost of transporting the two different types of garment making machines (i.e. both the AD and Western types) by road—from the transit country to Uganda—is the same. However, the less capital intensive nature of the AD garment making machines makes the transport cost of the AD machines more expensive relative to those from the Western economies.

I also found that the landlocked nature of Uganda was identified as a major challenge for technology transfer into Uganda. Uganda's landlocked nature makes the cost of transferring the technology more expensive and difficult than for its maritime neighbours—Tanzania and Kenya (Chapter 6). A garment making machine will have to be transported for a total of 1,162 kilometres from Kenya to the borders of Uganda (Chapter 6). I further conclude that Uganda has no control over trade policies of its maritime neighbours and so any changes in tariffs at the Kenyan port affects the cost of clearing the capital equipment at the port (Chapter 6). These issues lead to increases in the cost of transporting the garment making machines and also affect their bottom-line prices in Uganda.

Answers to this question also points to the fact that the ADs play a significant role when it comes to the importation of garment making machines into Uganda. They have the requisite haulage trucks required for the importation of large cargo of garment making machines into the country. Besides, they—the AD economies—play a complementary role in the transfer of technologies from the Western economies to Uganda. As indicated in Chapter 6 above, the AD firms have the haulage trucks for the transportation of Air transport is the alternative route for transferring garment making technologies into the country. It is faster but more expensive and carries less cargo compared to sea transport. Hence, it is less preferred compared to the sea.

Mode of transfer at the large scale level of garment production

At the large scale level, I found a very different situation. I found that FDI and cross border movement of personnel are the two most important channels through which technologies are transferred into Uganda. In the case of FDI, the study showed that before the year 2000, there were fewer AD investments in the garment sector relative to those from the West. As such, technology transfer through FDI was mainly from Western economies. However after the year 2000, the number of AD investments outstripped those from the West. The increasing AD investments after the year 2000 also resulted in an upsurge of AD garment making machines in the sector (Chapters 3 and 6). Unlike the Western technologies, the AD technologies are serving as a means of entry for potential local large scale garment making entrepreneurs in Uganda. In part, it has also made local entrepreneurs who are already in business competitive since they have easier access to AD capital equipment at a relatively cheaper cost (Chapter 6). I further found that due to poor remuneration, labour turnover rate in the AD firms is higher and this has contributed to a higher rate of skills and knowledge transfer (soft technology) from them to the local garment producers. The average turnover rate for the AD firms is 35 % whereas that of the Western firms is 13 % (Chapter 6).

The other mechanism of transfer of technologies at the large scale level, and recognising the wider definition of technology used in this thesis, is cross border movement of personnel. Cross border movement of personnel also lead to the transfer of skills and knowledge to the local garment producers. The study found that cross border movement of personnel in the short run increases output because expatriate workers are available to ensure that all the sophisticated garment making machines operate efficiently. However, the study found that they stay for a short period and then go back. Thus, output can be affected in the long run when the machines breakdown and there are no expatriate workers to repair them. The increase in AD investment in the Ugandan garment sector has translated into cheaper and easier transfer of technologies in the form of expatriate knowledge and skills competences at the large scale level.

Relevance of the findings to literature

As indicated above, the starting point was the theory of technology transfer. This theory provided key analytical tools that enabled the study to discuss the empirical evidences on the mechanisms of transfer of garment making machines in the country. The first insight identified three modes of transfer of garment making machines into the garment manufacturing sector Uganda. The findings on this research question confirmed that technology transfer through direct import and marketing, FDI and cross border movement of people are among the important mechanisms in technology transfer to developing countries (see Faye, *et al.* 2004, Arvis *et al.* 2010, Morrissey and Rudaheranwa, 2012, and Milner *et al.* 2013). Available literature does not focus much attention on the challenges facing developing landlocked countries in the transfer of technologies. Thus, this study adds to literature by showing the challenges and difficulties landlocked Uganda confronts in the process of transferring technology into the garment manufacturing sector.

Additionally, FDI from the AD economies to African countries like Uganda has mainly focused on primary commodities and infrastructure (Farooki and Kaplinsky, 2012, Brautigam, 2009 and Dent, 2011) but not manufacturing. Issues raised in literature pertaining FDI from the AD economies to developing countries is the fact that the AD economies invest in infrastructure in return for primary commodities in Africa. Other studies focus on the negative effects of China's investments in Africa's primary commodities sector. This study contributes to literature by showing that the AD economies are also investing in the manufacturing sector in Uganda.

10.3.2 Conclusions from the findings relating to research question two

Does the degree of distribution of the AD garment equipment differ from those of the Western ones in Uganda?

This question was answered primarily in Chapter 6. In answering this question, I based the discussion on the rate of adoption, distribution among different groups of machine users (i.e. in terms of gender, user in urban and rural areas etc) and access to the garment making machines. The analysis was extended to compare the effects of the distribution of the AD and Western garment making machines on inequality in Uganda.

Summary of gaps in the distribution literature

The research question was built on the theory of technological distribution. Studies such as Blackman (1999), Prahalad and Hammond (2002), Archibugi and Pietrobelli (2002), and Comin and Hobijn (2010) have addressed the relevance of information in the distribution of technologies in developing countries, but their focus did not cover both the formal and informal sectors of the economy. Standard literature also recognises the well-developed financial market in the Western economies as the source of finance for diffusion and not those in developing countries like Uganda. In addition, the diffusion literature is narrowed in favour of the spread of Western technologies in developing countries and not those from the AD economies. Comin and Nanda (2014) and Spolaore and Wacziarg (2011) are among the few studies that focused on financing the distribution of technologies. Even that their emphasis was on the well-established financial markets.

Research findings on question two

1. *Access to information*

My findings show that information played a crucial role in the adoption of the garment making machines. The low demand for the AD garment making machines before the 2000s was mainly due to insufficient information on them. The insufficient information about the AD garment making machines fuelled some degree of uncertainty about them before the 2000s. I found that 95 % of the garment producers who acquired garment making technologies in the 1960s acquired the Western type. However, the rate of adoption declined significantly after the 1960s. After the year 2000, demand for the AD garment making machines surpassed the Western ones as a result of users getting enough information on the machines. The uncertainty issues that were associated with the AD machines had reduced significantly. The liberalisation of the Ugandan economy, coupled with an increase in AD-Uganda trade in garment making machines were the key drivers to the information access and reduction of uncertainty (Chapter 6).

2. *Finance as a means of distribution of garment making machines*

I found that it is relatively easier to access credit from the local financial institutions to import AD technologies from their sources of manufacture, relative to the Western technologies. This is motivated by the high demand for AD garment making machines on the local market. As indicated in Chapter 6 above, commercial banks find it more convenient to administer financial credits to traders of the AD machines since it is easier to recover the loans (Chapter 6). Furthermore, the high cost of the Western garment machines led to a decline in demand for the Western garment making machines. Hence, the commercial banks find it more risky to administer credits to importers and traders of Western garment making machines.

3. *The pattern of distribution*

In general, the study shows that the AD garment making machines are more widely distributed than the Western ones in Uganda. In terms of distribution by location, they—AD garment making machines—are more widely spread in rural areas than in urban areas. This is because they are affordable and easier to operate in the rural areas. The level of penetration of the Western garment making machines is however greater in urban areas than in rural areas. These are electric powered Western made machines which produce at a faster rate compared to the AD ones. The bulky and capital intensive nature of the Western machines makes it difficult for garment producers in rural areas to acquire the Western made machines. Furthermore, the AD garment making machines are more distributed among female garment producers—particularly those in rural communities. In sum, I conclude that the distribution of the garment making machines in Uganda is a function of information, access to finance and the location and gender of the user.

Relevance to theory

As indicated above, studies like Blackman (1999), Archibugi and Pietrobelli (2002) and Comin and Hobijn (2010) are among the few empirical studies that consider information as a means of diffusion in developing countries. Rogers (2003) underscores the relevance of information for the diffusion of technology. Dissemination of information about a technology reduces uncertainty and allows diffusion to take place in a wider social system (Kasmire *et al.* 2012). The issue is that technologies can be complex and so information about it may take some time for it to be well disseminated (Kasmire *et al.* 2012). All the above theories were based on evidence from the Western technologies and not technologies from other sources. This study fills this gap by showing that dissemination of information is important for stimulating demand and reducing uncertainty on technologies from sources—AD economies—other than Western economies.

The diffusion literature has pointed to the importance of access to finance as one of the main factors that influence the diffusion of technologies. Failure to provide financial support in the distribution process of technologies can prevent or delay the adoption of specific technologies (Spolaore and Wacziarg, 2011). As indicated above, these studies mainly focus on financing the distribution of Western technologies and not AD machines. They also consider the well-developed financial firms and not the less developed ones like those in Uganda. The low cost nature of the AD garment making machine has led to an increase in demand. As such, the local commercial banks find it less risky to administer loans for their trade. This study has gone a step further to show the importance of finance from the local commercial banks for the distribution of AD garment machines in developing countries, using Uganda as a case study.

10.3.3 Conclusions from the findings relating to research question three

How distinctive are AD and Western garment equipment in developing countries?

I answered this question by describing the properties of the AD and Western garment making machines at each stage of the garment value chain—pre-sewing, sewing, and post sewing stages (Chapter 5). This discussion was done at the small and large scale levels of garment production (Chapter 5). This question was premised on the appropriate technology and rise of the Asian Drivers' literature. Answers to this question sought to validate (or otherwise) the assumptions in the rise of the AD literature that technologies from the AD economies are likely to be robust, tolerant to weak infrastructure, and less skills intensive.

Findings on question three

This study found that the AD making machines are distinctive from the Western ones. This distinctiveness was cumulatively positive in relation to the overarching objective of this study but does not mean they were all positive. Five important factors distinguished the AD garment making machines from that of the Western technologies. These are:

robustness, skills requirement, access to machine and spare parts, infrastructural requirements and creation of jobs.

1. *Robustness of the garment making machines*

I found that the Western garment making machines are more robust than the AD ones. This is mainly because the AD machines have weaker parts and also breakdown frequently during sewing (Chapter 5). This causes a lot of delays when using the AD machines for garment production. For instance, I found that the ADSMs break down on average twice every year while the Western sewing machines break down once every two years (Chapters 7 and 8). This leads to frequent replacement of various parts (e.g. bobbins, needles, electric motors etc) of the AD machines compared to the Western ones. As such, the Western machines appear more reliable for the production of garment. The Western garment making machines are relatively bulky and this affects its speed when it is been operated manually.

2. *Skills requirement*

On the whole I found that it is easier to operate AD garment making machines relative to the Western ones. Those who operate the Western garment making machines acquired the requisite skills to do so after years of operating the machine. The AD machines on the other hand are simple to operate and therefore can be operated with minimum/or no supervision. But care is required to minimise needle breakage. Beginners in garment production mostly use the AD garment making machines as a result of their simple nature. In addition it is relatively easier to repair. However the frequent breakdown of the AD garment making machines makes it skills intensive, since more repairers will have to be trained for repair works. On average, the ADSMs break down twice a year; but that of the WSM is once every two years. As indicated in Chapter 5 above, each repair firm employs 5 workers (including apprentices). This means that skills training in repair works can lead to the creation of jobs (see Chapter 9). The Western machines break down less frequently relative to the AD ones, but the former is relatively difficult to repair. Repairs are able to repair fewer quantities of the Western machine per given period. Thus, contrary to my expectation, both machines are skills intensive.

3. Access to the garment making machines and spare parts

As I have explained in Chapter 6 above, the wider distribution of the AD garment making machine in rural communities has also resulted in easier access to AD machines relative to those from the Western economies. I found that garment producers living in a rural environment travel an average of 15 kilometres to be able to purchase an AD garment making technology. However, the same producer will have to travel further (i.e. 113 kilometres) to be able to purchase Western technologies (Chapter 6). I also found that garment producers in urban locations find it easier to access garment making machines relative to those in rural areas. This is due to the fact that the majority of the garments making machine traders are located in urban areas. This is largely due to the high cost of transporting the machine to the rural areas. However, the distance travelled to access AD garment making machines in urban areas is shorter than that of the Western machines. In the same vein, access to spare parts for the AD garment making machines is easier than those of the Western machines. At the large scale level for instance, parts of some of the Western machines—like knitting and weaving machines—are not available on the local market. So, they import them from their respective countries of manufacture. However, those of the AD machines are pervasive on the local market and relatively affordable compared to the Western ones.

4. Infrastructure requirement

I found that the electric WSMs produce greater quantities and better quality of garments than the electric ADSMs in urban areas. However, in rural areas where there is no electricity infrastructure, the quantity of garments produced by the manual ADSMs is more than that of the manual WSMs. However, output will be higher in rural areas when AD garment making machines are used. As indicated above, the AD machines are less bulky and easier to operate relative to the Western ones. As a result, machine users are able to produce more garments with it than the Western ones. Furthermore, the general cost of energy for the ADSMs is lower than that of the WSMs despite the fact that both machines use a 5 hp electric motor. At the industrial level, firms use electric power for both machines in order to produce garment faster for their clients. Even that the annual cost of power for the industrial WSMs (US $ 32.00) is higher than that of the industrial ADSM (US $ 27.00). Thus I conclude that energy infrastructure is critical when higher productivity is to be achieved with the Western garment making machines. This also meets my expectation that the AD machines are less reliant on infrastructure.

Relevance to literature

The appropriate technology theory characterises technologies from the advanced economies as skills intensive. However, the base of skills in most African developing countries is very low. Alongside, is a low level of education and technological capability which renders the manufacturing sector less competitive in developing countries (Stewart, 1982).The rise of the AD literature shows that wages in the AD economies are a fraction of those in the Western economies (Kaplinsky, 2010 and 2011). Therefore, among others it is likely that new technologies produced in the AD economies are more likely to be robust, less reliant on infrastructure, low cost, and less skills intensive (Clark *et al.* 2009; Kaplinsky, 2010 and 2011). My findings validate the assumptions that technologies from the AD economies to developing countries are less reliant on infrastructure, low cost and easier to access. Contrary to my expectation, my findings do not validate the assumption that the AD technologies are less skills intensive in developing countries.

10.3.4 Conclusions from the findings relating to research question four

Does the level of profitability of the AD garment equipment differ from those from the Western economies?

The private and social profitability of the two sets of garment making machines were considered for this question. I focused on only sewing machines from the AD and Western economies for answers to this question. I started with an analysis on the coefficients of production of the ADSMs and WSMs. This focused on the physical properties of labour, output and acquisition capital costs of the two garment making machines. This was followed by an analysis of the private profitability (i.e. returns) of the two alternative sewing machines—ADSMs and WSMs. The private profitability of the two different types of sewing machines is a function of the technical coefficients of production, by factor prices and operating conditions. This analysis was done in Chapters 7 (for small scale garment machines) and 8 (for Industrial garment making machines). Private profitability of the two sewing machines was estimated in rural and urban areas at the small scale levels. The industrial sewing machines were considered in only urban areas.

Gaps in relevant literature

This question was built on the theory of technological choice, technical change and appropriateness. The neoclassical production function considers only two factors for the production (Stewart, 1982 and Kaplinsky, 1990). This study enriches the literature that objects to these assumptions by showing that products and factors are differentiated and that other factors such as energy, skilled labour, and intermediate inputs are all very important in the production process. Opponents of appropriate technology argue that the efficient technologies only originate from the Western economies (Eckaus, 1987 and Emmanuel, 1982). This study shows that there are technologies from other sources—AD economies--that are efficient. Furthermore, there is not enough evidence in current studies that compares the level of profitability of AD machines from different source. This study focuses on filling these gaps in available literature.

Research findings

The research finding to this question focused on three main areas—the production coefficient, the private and social profitability of the two sewing machines. The production coefficients and private profitability of the alternative machines was considered in Chapters 7 and 8. The social profitability was however based on a scenario analysis of appropriateness in Chapter 9.

Production coefficients for the two machines

Compared to the WSMs there were a higher output capital ratio and a lower output labour ratio for the ADSMs in urban areas at the small scale level. However, the WSMs are "economically inefficient" in the rural communities. This is because they recorded a lower productivity of both capital and labour (Chapter 7). Therefore, the choice of technique in the urban communities will reflect the factor prices, assuming that product quality is constant. Conversely, there is no set of factor prices that will inform the choice of the Western garment making machines if the products are homogeneous in rural areas (see Chapter 7). At the large scale level, I found that the capital productivity of the WSM is higher than that of the ADSMs (Chapter 8). However, labour productivity for the ADSMs is superior compared to the WSMs. Therefore, both technologies are economically efficient at the large scale level.

1. *Private profitability of the ADSMs and WSMs*

In terms of value addition, I found that the WSMs add more value to garments than the ADSMs. The ADSMs skip stitches and produce weaker seams; and these negatively affect the quality of seams. The WSMs generally produce higher quality seams and this adds more value to the garment. The resultant effect is a higher profitability for the WSMs. The issue is that the WSM produces fewer garments in rural areas and consumers are less likely to pay a premium for higher quality products so its users record lower profits. Thus in rural areas, the ADSMs yield higher private profitability than the WSMs. Yet, in urban areas the WSM yields higher private profitability than the ADSMs. Furthermore, the private profitability of the industrial WSMs is superior to that of the ADSM. Similar to the small scale technologies the industrial WSMs are only efficient and profitable in locations with energy infrastructure. Thus, the Western technologies are only privately profitable when there is power infrastructure and higher income consumers available. Hence, the study concludes that the wider spread of the ADSM does not reflect their profitability levels.

2. *Social appropriateness of the ADSMs and WSMs*

This was investigated by a measurement of the social appropriateness of the two alternative sewing machines using scenarios that are focused at the national level (Chapter 9). This was aimed at comparing the extent to which the ADSMs and WSMs can create jobs, as well as satisfying the garment needs of the country. I used both manual and electric sewing machines from both AD and Western sources for the analysis at the small scale level. The industrial (electric) sewing machines from both Western and AD sources were considered at the commercial level (Chapter 9). In setting up the discussion on the social appropriateness, three key policy documents in Uganda were considered—the National Development Plan of Uganda 2010/11-2014/15, the National Industrial Policy of Uganda, and the National Textile Policy of Uganda.

These official documents were considered for the appropriateness scenario based on their expected common policy outcomes. These three documents aim at creating employment, increasing output, and investing in technology and infrastructure development (Chapter 9). I focused on these four objectives to analyse two appropriate scenarios for the ADSMs and WSMs. The first scenarios compared the number of jobs that a ADSMs and WSMs can create with a fixed capital of US$ 10 million. The second scenario focused on creating jobs and acquiring more capital equipment with a given capital for the production of 73 million "kitenge shirts" every year. These scenarios were considered based on the following assumptions: (1) the two sewing machines produce homogeneous products. (2) Both technologies are in the same condition (3) The products can be sold within a given period.

I found that relative to the electric WSMs, investing in only the electric ADSMs in urban areas at the small scale level will create more jobs and firms. However, the less capital intensive manual sewing machines make it easier to acquire more of them than the electric ones. In addition, the electric sewing machines require energy infrastructure to operate and this may serve as a barrier for garment producers in rural areas since energy infrastructure is absent. Contrary to my expectation, the manual WSMs create more small scale firms and jobs than the ADSMs in rural areas. This is because in rural areas, more of the manual WSMs will be required for the production of garments within a given period of time (Chapter 9). The main issue is that WSMs will come at a relatively higher cost compared to the ADSMs. In conclusion to the social profitability of the two technologies, the AD technologies have more employment creation attributes than the Western technologies, though the former produces a smaller quantity of garments. I also conclude that the AD technologies have the potential of meeting Uganda's strategic objective of establishing micro and small scale garment making firms—this is in an attempt to create jobs and ultimately achieve economic growth (GoU, 2008 and GoU, 2009). I further found that the AD technologies generate more surpluses relative to the Western technologies in rural areas. The situation is different in urban areas—the Western garment making machines are higher than those of the AD technologies.

Relevance to theory

The theory of technological choice, technical change and appropriateness were considered for the study. The theory of technological choice led to a detailed discussion on the objections that were raised on the assumptions of the neoclassical framework. First, the neoclassical assumptions indicate that factors are continuous and homogeneous in a perfectively competitive market (Clark, 1985, Stewart, 1982 and Kaplinsky, 2010). However, opponents of this assumption indicated that technologies produce differentiated products (Eckaus, 1955). This study provided evidence to support the opponents of the neoclassical approach on this assumption (see Chapters 7 and 8). Again, the concepts of technological choice also guided me to identify techniques that are capital and labour intensive. This study has made inputs into theory by using AD garment making technologies to show that efficient technologies can also originate from developing countries and not only Western economies.

10.4 How the results against the four research questions address the overarching objective

The primary objective of this study is to examine the distinctiveness and profitability of garment machines in Uganda. In achieving this objective, I focused on the modes of transfer and distribution of garment making machines from the AD and Western economies to Uganda in questions 1 and 2 respectively. In question 1, I showed that direct imports and marketing, FDI and cross border movement of personnel were the main channels of transfer of the AD garment making machines into Uganda. In question 2, I demonstrated that the AD garment making machines are widely distributed and easier to access. However prior to the year 2000, inadequate information made it initially difficult for the adoption of the AD technologies. The distribution of the AD garment making machines became wider after the year 2000 when potential users had enough information on the machine. Furthermore, the spread effect of the AD garment making machines was positive on inequality reduction.

Questions 3 and 4 focused on the distinctiveness and profitability of the two garment making machines respectively. In Question 3, I provided evidence to show that the AD garment making machines are tolerant to weak infrastructure, but contrary to my expectation they are less robust and yet also skills intensive. Moving on to Question 4, I showed that the AD garment making machines add less value to garments compared to the Western garment making machines. This is mainly due to the quality of seams they produce. It is also due to the fact that the WSMs produce smaller quantities relative to that of the ADSMs, users of the ADSMs recorded higher profitability in rural areas. This notwithstanding, in urban areas the ADSMs yield lower profits relative to the WSMs.

Furthermore, investing in only ADSMs leads to the creation of more small scale firms and jobs.

Overall therefore, this study has addressed the overarching objective and found that the AD economies are serving as alternative sources of garment making machines for developing countries like Uganda. Firms from the AD economies also play an important role in the transfer of soft technologies into the country. More importantly, the Indian ADs transfer tacit knowledge, managerial and technological know-how to the local garment producers in Uganda. Thirdly technologies from the AD economies are pro-poor relative to those of the Western firms. These pro-poor technologies are also efficient but skills intensive. I also found that trade, FDI and cross border movement of personnel play a very crucial role in the transfer of technologies into Uganda. However the cost of transferring garment making machines into a landlocked country is more expensive compared to the country's maritime neighbours. Finally, the pro-poor nature of the AD garment making technologies serves as a means of entry for the potential garment producers in Uganda.

10.5 Policy Implications

In addition to the underlying assumptions relating to the literature on technologies this thesis has implications for policy formulation for the manufacturing sector in Uganda. It also has a wider policy implication relating to the creation of jobs, reduction of inequality and poverty in the face of the 'rise of Asia'. It is in relation to these two latter issues that discussions regarding appropriate technologies has resurfaced among academics in recent years – as discussed in Chapter 2. Notably, my research has implications for the following policy areas:

- ✓ Need for a technology transfer policy
- ✓ Efficient dissemination of information
- ✓ Emphasis on manual AD technologies
- ✓ Need for skills training

I discuss the implications of each of the above in more depth in Sections 10.5.1 to 10.5.4.

10.5.1 Need for a technology transfer policy

First, the study has underscored further the problems affecting Uganda due to the fact that Uganda is a landlocked country and this result in higher cost of import of capital equipment into the country (Faye *et al.* 2004 and Rudaheranwa, 2009). As a result, Uganda often lags behind its maritime neighbours in overall development and external trade. Therefore, there is the need for a technology transfer policy that encourages the creation of an enabling environment that will leverage a smooth transfer of technologies into the country at relatively cheaper cost and at a shorter period. The policy must focus on the following

1. Efficient collaboration through the country's maritime neighbours
2. Efficiency in the transport sector

1. Effective collaboration with the country's maritime neighbours

As mentioned earlier, Uganda is affected by the trade policies and access to the seaport of its maritime neighbours—Kenya and Tanzania. As such, Uganda needs to establish a strong collaboration with these two countries in order to reduce the cost of transporting the technologies. This can be done through the East African Community (EAC) Customs Union and The Common Market for Eastern and Southern Africa (COMESA) of which Kenya and Tanzania also belong. As a member of the EAC Customs Union and COMESA regional grouping, the country stands to benefit from a number of regional transit and transport policies (Rudaheranwa, 2009). Examples are the application of harmonised road transit charges and axle limits, regional third-party motor insurance scheme (COMESA Yellow Card) which aids in the reduction of transaction costs and delays associated with national customs clearances and documentation for transit shipment (Rudaheranwa, 2009). Again, as an EAC member, Uganda can advocate a common customs control policy that will be implemented by the customs administration along the transport corridors of member states. Through this, there will be harmonised, simplification and standardisation of these processes. This will also enable Uganda to have a voice in the trade policies (particularly the tariff regime) in Kenya and Tanzania.

There are empirical studies that underscore the importance of this regional integration approach. Studies such as Cárcamo-Díaz, (2004) have shown that regional integration can reduce the problems of landlocked countries by fostering trade. Cárcamo-Díaz also buttresses the point that regional integration can raise rates of return on investment in transport infrastructure, thus making it attractive for the private sector to invest in transport infrastructure. This will lead to a reduction of transport cost for the landlocked country (Faye et al., 2004). Cárcamo-Díaz (2004) has shown in his work titled *"Towards development in landlocked economies"* that regional integration can lead to a fall in the cost of transportation through a transit country. It can also lead to a reduction in cost of border crossings between a landlocked country and transit country (UNCTAD, 2013). This includes trans-shipment and waiting times, bureaucratic obstacles, customs costs, etc. In addition, fluctuation in bilateral exchange rate becomes less important and so allows the importer to plan well.

2. *Efficiency in the transportation and clearing system*

Institutions and regulatory systems must be resourced enough to be able to deliver services on time so as to avoid additional delays at the country's border entry points. For instance, introducing a 24 hour clearing system through shift working will help minimise delays and associated trade costs. In addition, clearing of imported capital equipment at the Ugandan border must be accorded some priority. This will reduce import costs and improve competitiveness in the manufacturing sector. There is also the need for a long-term solution which requires a rigorous upgrading policy and improvement in the transportation system in both the country and its maritime neighbours. However, infrastructure development requires huge investment. Thus, through regional groups like EAC and COMESA, a road infrastructure development fund can be instituted.

10.5.2 Efficient dissemination of information

The study has shown that inadequate information on the AD technologies delayed their adoption until the 2000s. Information plays a very significant role in technology transfer in developing countries like Uganda. Therefore the Ministry of Trade, Industry and Cooperatives should establish an information advisory bureau on the various technologies in the manufacturing sector. In the garment sector for instance, Textiles Development Agency must be well resourced to deliver information on the various garment making technologies. This can be done concurrently with skills development. Furthermore, investors, importers and traders should be urged to employ more local employees to familiarise themselves with the various technologies available. Through this, local firms will be able to access information on various types of technologies that are appropriate for industry.

10.5.3 Emphasis on manual AD technologies

My study has shown that AD technologies are relatively less capital intensive, can operate more efficiently in locations with no energy infrastructure and are more accessible than the Western technologies. However, they yield relatively lower returns than the Western ones. In a country where inequality is on the rise with rising youth unemployment, Uganda's embryonic garment manufacturing sector as a policy should focus on sacrificing higher profitability for sustainable job creation at a lower cost. This can be achieved by adopting manual sewing machines. As indicated in Chapter 9 above, more manual AD garment making machines can be acquired with a given fixed amount of capital relative to the other machines. Therefore, the garment sector in Uganda should encourage the acquisition of more manual AD garment making machines. This will help create more firms and jobs in the sector. Therefore the emphasis on technologies that have properties like those of the AD technologies will be appropriate. Furthermore, it will serve as a channel of entry for potential entrepreneurs and also assist existing local producers to expand their businesses. As indicated above, the AD technologies have a wider income distribution attributes than the Western machines; though users of the latter earn higher income. Thus, there must be emphasis on income distribution so as to close the inequality gap.

10.5.4 Need for skills training

The study has shown that machine operators for both AD and Western garment making machines require some level of skills training to operate the machines despite the fact that the AD technologies are easier and simpler to use. Skills training for the AD technology come in the form of repair work as well as handling of the machine in a way that will produce quality outputs. The Tan and Batra (1996) used firm level data to show the relevance of skills development in six developing countries—China, Colombia, Indonesia, Malaysia, Mexico, and Taiwan. The output from the study showed that firms that invest in skills developments achieve higher productivity, job creation and growth.

At the national level, the majority of the Ugandan population (62 %) is unskilled/or semi-skilled, with agriculture as their main source of livelihood (GoU, 2012). Hence, the country's ambition to move the excess labour from the agricultural sector to manufacturing will require some form of skills training in order to enhance growth and productivity in the manufacturing sector. This will also create sustainable jobs for labour in rural areas. In view of this, the technology transfer policy must emphasise skills development on the relevant technologies that are required for the development of its manufacturing sector. This form of skills development can be facilitated through public, private participation. There is the need to foster cooperation between the various large scale firms (particularly the foreign ones) to bring their expertise to bear in the training of potential machine repairer.

I showed in Chapter 6 that TEXDA is among the few organisations that offer training in garment manufacturing in Uganda. So, TEXDA can be empowered to champion skills training on garment making technologies. Through this, actors in the industry will be able to identify the most appropriate technology that they require for garment production. They will be well informed about the various technological upgrades that are occurring on the global front. Officials of TEXDA must also be given technological use and productivity training programmes so as to develop their capacity at the enterprise level as well as undertake study tours to other countries to learn from them and establish south–south co-operation. Still on skills development, the Ministry of Trade, Industry and Cooperatives must promote the establishment of technology based incubators in order to improve capacity and competence of indigenous entrepreneurs.

10.6 Limitations of the study

As explained in Chapter 3 above, access to data from the AD firms was challenging. Thus, this study was limited to fewer respondents from the AD firms compared to those in the local garment producers. This study is a single sector study. Such studies have been subject to criticism. Notable among them is that single sector studies are subjective and may not be appropriate for external validity (Holland and Campbell, 2005). However this study never set out to be generalisable. Its aim was to provide a nuanced empirically rich, holistic account of the role of the Asian Drivers as a source of garment making technologies in Uganda that would add case study material into a field that has little empirical work as yet in relation to role of firms from AD economies in technology transfer. As outlined in Chapter 2 few people have considered the role of the AD economies from this perspective and those that have, have only hypotheses on the issue. As such this study has filled an important gap in literature by demonstrating that the rise of the AD economies is serving as an alternative source of technologies for developing countries like Uganda. The next step would be a wider study that covered multiple sectors and/ or multiple countries in order to understand the degree of generalisability to these findings. I now discuss this and other possible future research.

10.7 Suggestions for future research

I am confident that I have been able to accurately reflect the growing presence of AD hard and soft technologies in the garments sector in Uganda, so there is little point in augmenting this research. However, the following issues are worth considering for the enhancement of this research:

1. Seeking the views of makers and exporters of garment making machines in the AD and Western economies in future studies. This will identify the factors driving the trajectories of their technologies and any innovations which they think may be useful for developing economy markets like Uganda. This will also present the story from the suppliers' perspective. Furthermore, it will help establish the reason why they don't make greater efforts to market their products in the garment sector in order to fill the information gap I observed (see Chapter 6).

2. The study can also be extended to textiles production (up the value chain) and marketing (down the chain) to assess the presence and distinctiveness of the AD and Western technologies in the whole chain and their implications for garment production. I know for a fact that Indian firms are involved in this part of the chain, but it will be an interesting adjunct to focus on China in the textiles link of the value chain. In fact this was part of my original target however; I later decided to focus on garment making machines as a result of limited availability of data in the textiles sector.

3. Furthermore, it is worth extending the study to other sectors of the economy; for example food processing, agriculture and oil extraction. This will contribute in generalising the finding of study across various sectors in Uganda.

4. It would be interesting to undertake research from a cross country perspective, particularly from the perspective of other African economies like Ghana (my home country).

5. Further research should attempt to build understanding of the role of longer standing migrant entrepreneurs from emerging economies and on the interactions between old and new migrants from these economies. In the Ugandan context, this predominantly relates to Ugandan citizens of Indian descent.

REFERENCES

Abdallah, Y. A. and Apaa-Okello, J. (2009). “An Evaluation of the Impact of Reforms in Services on Downstream Manufacturing: Evidence and Policy Implications for Uganda's Non-Financial Services”, Services Sector Development and Impact on Poverty Thematic Working Group, Trade and Industry Policy Strategy, pages 24-26.

Abramovitz, M. (1956). ‘Resource and Output Trends in the United States since 1870’, American Economic Review, Vol.46, May, pages15-23.

AEO (2012). “African Economic outlook: Uganda country report 2012”, published by AfDB, OECD, UNDP, UNECA. www.africaneconomicoutlook.org.

Aggarwal, A. (2011). “South-South cooperation in technology transfer and the clean development mechanism some explorations”, Tech Monitor, May-June edition, pages 37-39.

Aggrey, N. (2009).”Patterns of Agricultural Growth and Overall growth of Ugandan Economy”, Department of Economic Policy and Planning, Faculty of Economics and Management, University of Makerere, Uganda, pages 6-9.

Akisimire, R., Abaho, E. and Basalirwa, E. M. (2015). “Microfinance and entrepreneurial empowerment of women: The Ugandan context”, International Journal of Economics, Commerce and Management, Vol. III, Issue 1, ISSN 2348 0386, page 4.

Aldrich, W. (1994). CAD in Clothing and Textiles, Wiley-Blackwell, John Wiley and Sons, (2nd Edition), pages 51-62.

Aliaga, M. and Gunderson, B. (2000). Interactive Statistics, Prentice Hall ISBN 10: 0132310368, pages 3-15.

Amsalem, M. A. (1983). Technology choice in developing countries: the textile and pulp and paper industries, 6th Edition, Cambridge, Mass: MIT Press, pages 10-25.

Ancharaz, V., Ghisu, P. and Wan, J. (2014). “Uganda: Deepening Engagement with India through Better Market Access” International Centre for Trade and Sustainable Development, Geneva, Switzerland, Issue Paper No. 33, pages 8-9, www.ictsd.org.

Antonius, R. (2003). Interpreting Quantitative Data with SPSS, London: Sage Publications, pages 18-36.

Archibugi D. and Pietrobelli, C. (2002). “The globalisation of technology and its implications for developing countries Windows of opportunity or further burden?”, Technological Forecasting and Social Change, 70 (2003) pages 861–883, Elsevier Science Inc.

Arrow, K. J., Chenery, H. B. Minhas, B. S. and Solow, R. M. (1961). "Capital-Labor Substitution and Economic Efficiency", Review of Economics and Statistics, 43, pages 225-250.

Arrow, K., (1969). “Classificatory notes on the production and transmission of technological knowledge”, American Economic Review, Papers and Proceedings, May, pages 244–250.

Arrow, K.J. (1962). "The economic implications of learning by doing", The Review of Economic Studies, Oxford University Press Stable Vol. 29, No. 3 (Jun., 1962), pages 155-173.

Arvis, J-F., Raballand, G and Mareau, J-F. (2010). The Cost of Being Landlocked Logistics Costs and Supply Chain Reliability, The International Bank for Reconstruction and Development, the World Bank paper publication 55837, ISBN 978-0-8213-8408-4, pages 8-15

Baffes, J. (2009). "The Cotton Sector of Uganda", Africa Region Working Paper Series, World Bank, No. 123, page 8.

Baffoe, J.K. (2000). "Structural adjustment and agriculture in Uganda", working paper-WP.149, International Labour Office, Geneva, pages 1-10.

Bascavusoglu, E. (2005). "Does International Trade Transfer Technology to Emerging countries? A Patent Citation Analysis", An Open University research centre on Innovation, Knowledge and Development, Working Paper No 14. pages 4-6.

Bechhofer, F. and Paterson, L. (2000). Principles of Research Design in the Social Sciences, London: Routledge, pages 145-152.

Berg, B.L. (1998). Qualitative Research Methods for the Social Sciences, 3rd Edition, Boston, Massachusetts: Allyn and Bacon, pages 20-49.

Bhagavan, M.R. (1979). "A critique of appropriate technology for developing country", This report is published by The Scandinavian Institute of African Studies in cooperation with the Swedish Agency for Research Coorperation with developing countries, Research Report No. 48. pages 19-38.

Bhalla, A.S. (1985). Technology and Employment in industry, International Labour Organization, 2nd, revised and enlarged edition, pages 25-42.

Bigsten, A. (2000). "Globalization and Income Inequality in Uganda", Paper presented at the conference on Poverty and Inequality in Developing Countries: A Policy Dialogue on the Effects of Globalization", Organisation for Economic and Co-operation and Development, Development Centre, Paris, page 33-54.

Blackman, A. (1999). "The economics of technology diffusion: implications for climate policy in developing countries", a discussion paper 99-42, Resource for the Future, Washington D.C. pages 6-12. http://www.rff.org.

Blazquez-Lidoy, J. Rodriguez, J. and Santiso, J. (2004). "Angel or Devil? Chinese trade impact on Latin American emerging markets", mimeo, BBVA Research Department, Madrid. page 1.

Bless, C. (2000). Fundamentals of social research, Lansdowne: Juta. pages 10-34.

Bloom, D. Canning, D. and Chan, K. (2006). Higher Education and Economic Development in Africa, Human Development Sector Africa Region-The World Bank, page15.

Borensztein, E. De Gregorio, J and Lee, J-W. (1998). "How does foreign direct investment affect economic growth?", Journal of International Economics 45 (1998) pages 115–135.

Bozeman, B. (2000). “Technology transfer and public policy: a review of research and theory”, Research Policy paper 29 pages 627–655 Elsevier Science B.V.

Brackenbury, T. (1999). Knitted clothing technology, Blackwell Scientific Publications-Oxford, pages 23-40.

Brautigam D. (2009). The Dragon’s Gift: The real story of China in Africa, Oxford University Press Inc., New York, pages 55-56.

Bremner, J. and Zuehlke, E. (2009). “Integrating Population, Health, and Environment in Uganda”, Washington, DC: Report of the Population Reference Bureau, pages 14-26.

Brother Sewing Machine Manual (2009), “a Brother sewing machine guide for knowing your sewing machine”, pages 4-34.
http://www.mdc.umn.edu/facility/files/electrical/Elec%20Manuals/Sewing%20Machine%20User%20Manual.pdf

Bryman, A. (1988). Quantity and Quality in Social Research, Series 18, London: UNWIN HYMAN, pages 62-68.

Bryman, A. (2004). Social Research Methods, Oxford University Press, pages 15-32.

BTVET-Uganda (2003). “Business, Technical and Vocational Education and Training”, This report is the result of a consultancy commissioned by the Royal Norwegian Embassy in Kampala and Norwegian Agency for Development Cooperation (NORAD), pages 16-21.

Burgess, T. F. and Gules, H. K. (1998). “Buyer-supplier relationships in firms adopting advanced manufacturing technology: an empirical analysis of the implementation of hard and soft technologies”, Journal of Engineering and Technology Management,15, pages 127-152.

Cárcamo-Díaz, R. (2004). “Towards development in landlocked economies”, a United Nations Publication, ISSN printed version: 1680-8843, pages 10-14.

Carr, H. and Pomeroy, J. (1997). Fashion Design and Product Development, Blackwell Science, pages 10-25.

Carr, H., and Latham, B. (1994). The Technology of Clothing Manufacture, 2nd Edition, Blackwell Science, pages 31-45.

Christenson, C. (1997). The Innovator’s Dilemma, Cambridge, Mass: Harvard Business School Press, pages 12-24

Clark, N. G. (1985). The Political Economy of Science and Technology, Oxford: Blackwell, pages 81-87.

Clark, P.A. and Staunton, N. (1989). Innovation in Technology and Organisation, Routledge, London, ISBN 0415004225, pages 1-32

Clark, N., Chataway, J., Hanlin, R., Kale, D., Kaplinsky, R., Muraguri, L., Papaioannou, T., Robbins, P. and Wamae, W. (2009). “Below the radar: What does innovation in the Asian driver economies have to offer other low income economies”, Economic and Social Research Council, pages 14-19.

Coe, D. T., Helpman, E. and Hoffmaister, A. (1997). "North-South Research and Development Spillovers", The Economic Journal 107, pages 134-149.

Collier, J., and Collier, M. (1986). Visual anthropology: Photography as a research method, Revised Edition, Albuquerque, NM: University of New Mexico Press, pages 9-31.

Collier, P. (1999). "On the Economic Consequences of Civil War", Oxford Economic paper, 51, (1999), pages168-183.

Comin, D. and Hobjin, B. (2010). "An Exploration of Technology Diffusion", American Economic Review, American Economic Review 100 (December 2010), pages 2031–2059.

Comin, D. and Nanda, R. (2014). "Financial development and technology diffusion", Harvard Business School working paper Working Paper 15-036, pages 1-5.

Cooklin, G., Hayes, S. G., McLoughlin, J. and Fairclough, D. (2011). Cooklin's Garment Technology for Fashion Designers, Wiley-Blackwell, ISBN: 978-1-4051-9974-2, pages 22-31.

Cooper, C. and Kaplinsky, R. (1974). "Second-hand equipment in a developing country: A study of jute-processing in Kenya", in Bhalla (1985) (Ed), Technology and employment in industry, Geneva: International Labour Office, pages 129-153.

David, P. A. and Foray, D. (2001). "An Introduction to the Economy of the Knowledge Society", Department of Economics, University of Oxford discussion paper series, 84, ISSN 1471-0498, pages 1-10.

Dehaghi, M.R. and Goodarzi, M. (2011). "Reverse Engineering: A Way of Technology Transfer in Developing Countries like Iran", International Journal of e-Education, e-Business, e-Management and e-Learning, Vol. 1, No. 5, ISSN: 2010-3654, pages 347-353.

Dent, C.M. (2011). China and Africa Development Relations, Routledge Contemporary China Series, Routledge 2 Park, Abingdon, Oxon OX14 4RN, pages 121-142.

Denzin, N. K. and Lincoln, Y. S. (2000). Handbook of qualitative research, Thousand Oaks, CA: Sage, pages 24-35

Dobler, D. W., Burt, D. N. and Lee Jr., L.L. (1990). Purchasing and Materials Management: Text and Cases 5th Edition. NY, New York: McGraw-Hill, Inc., page 842.

Dosi, G. (1982). "Technological Paradigms and Technological Trajectories", Research Policy, Vol. 11, No. 3, pages 147-160.

Dutt, A. K. (2013). "South-south economic cooperation: motives, problems and possibilities", prepared for presentation at an URPE session on South-South economic integration and development at the ASSA meetings in Philadelphia, January 4, 2014, pages 2-15.

Eckaus, R. S. (1955). "The Factor Proportions Problem in Underdeveloped Areas", American Economic Review, Vol. 45, No. 4, pages 539-565.

Eckaus R. S. (1987). "Appropriate technology: The Movement Has Only A Few Clothes On", Issues in Science and Technology, Winter, pages 62-71.

Edwards, C. and Jenkins, R. (2005). "The Effect of China and India's Growth and Trade Liberalisation on Poverty in Africa", IDS / Enterplan, May 2005, pages 1-17.

Eichengreen, B., Rhee, Y. and Tong, H. (2004). "The impact of China on the exports of other Asian countries", NBER Working Paper, No. 10768, pages 4-14.

Elson, D. and Pearson, R. (1981). ""Nimble Fingers Make Cheap Workers": An Analysis of Women's Employment in Third World Export Manufacturing", Feminist Review, 7, pages 87-109.

Emmanuel, A. (1982). Appropriate or under-developed Technology?, J Wiley, Chichester, pages 3-22.

Eurostat (2011). "Income, Social Inclusion and Living Conditions Database", Luxembourg: European Commission. Accessed on 10 March 2011. http://epp.eurostat.ec.europa.eu/portal/page/portal/income_social_inclusion_living_conditions/data/database.

FAO (1997), Energy and Environment Basics, Second Edition, Regional Wood Energy Development Programme in Asia of the Food and Agriculture Organisation. Report compiled by Technology and Development Group University of Twente, Netherlands, RWEDP Report No. 29, GCP/RAS/154/NET, pages 14-27.

FAO (2012), "Analysis of incentives and disincentives for coffee in Uganda", A technical report for monitoring food and agricultural policy in Uganda, pages 11-31.

Farooki, M. and Kaplinsky, R. (2012). The impact of China on global commodity prices: The global reshaping of the resource sector, ISBN: 978-415-59789-0, Routledge, 2 park square, Abingdon, Oxon OX14 4RN, pages 60-74.

Faye, M. L., McCarthur J. W., Sachs, J D. and Snow, T. (2004). "The Challenges Facing Landlocked Developing Countries" Journal of Human Development Vol. 5, No. 1, pages 2-26.

Felner, W. (1961)."Two proposition in the theory of induced innovations", The Economic Journal, 1961, 71 (282), pages 305-308.

Findlay, R. (1978). "Relative backwardness, direct foreign investment, and the transfer of technology: a simple dynamic model", Quarterly Journal of Economics , 92, pages 1–16.

Fukunishi, T. (2009). "Has Low Productivity Constrained Competitiveness of African Firms?: Inter-Regional Comparison of Productive Efficiency and Competitiveness of Garment Firms", IDE-JETRO, pages 6-27.

Gereffi, G. and Frederick, S. (2010). "The Global Apparel Value Chain, Trade and the Crisis Challenges and Opportunities for Developing Countries", a World Bank policy research working paper 5281, pages 2-5.

Gill, K., Brooks, K., McDongall, J., Patel, P. and Ashihan, K. (2010). "Bridging the technology gap divide: How technology can advance women economically", An International Centre for research on women paper, pages 5-7.

Gittinger, J.P. (1982). Economic Analysis of Agricultural Projects, 2nd Edition, John Hopkins University press, pages 12-39.

GoU (2008). "Uganda Industrial Policy- A Framework for Uganda's Transformation, Competitiveness and Prosperity", published by the Uganda Ministry of Tourism, Trade and Industry, pages 11-34.

GoU (2009). "Uganda National Textiles Policy", a document published by the Uganda Ministry of Tourism, Trade, and Industry, pages 4-23.

GoU (2010). "Uganda National Development Plan 2010/11-2014/15", pages. 7-25 this paper is available on the IMF website as a Poverty Reduction Strategy Paper, also available on http://www.imf.org.

GoU (2010). "Uganda National Household Survey 2009/10", a document published by the Uganda Bureau of Statistics, pages 2-34.

GoU (2011). "Uganda National Housing Survey data 2009/10", report published by the Uganda Bureau of Statistics, pages 5-35.

GoU (2012). "Government of Uganda Statistical Abstract, 2012", report published by the Uganda Bureau of statistics, pages 23-29.

GoU (2013). "Uganda Statistical Abstratct-2013", a report produced by Uganda Bereau of Statistics, pages 20-41.

Griliches, Z. (1957). "Hybrid Corn: An Exploration in the Economics of Technological Change" Econometrica vol. 25, pages 501-522.

Griliches, Z. (1962). "Profitability versus interaction: Another false dichotomy", Rural sociology 27, pages. 325-30.

Grills, R. and Brown, S. (1975). Productivity in sewing operations, Shirley Institute, ISBN-13: 9780903669122, pages 55-76.

Guba, E. G., and Lincoln, Y. S. (1994). "Competing paradigms in qualitative research", in Denzin, N. K. and Lincoln, Y.S. (Eds.), Handbook of qualitative research Thousand Oaks, CA: Sage, pages 105-117.

Håpnes, T. and Rasmussen, B. (1991). "The Production of Male Power in Computer Science", in Eriksson, I. *et al.* (Eds): Women, Work and Computerization: Understanding and Overcoming Bias in Work and Education. Proceedings of the IFIP TC /WG 9.1 International Conference on Women, Work and Computerization: Kluwer, pages 395-406

Hicks, J. R. (1963). The theory of wage, MacMillan (Earlier version in 1932), pages 2-8.

Hillebrand, E. (2009). "Poverty, Growth, and Inequality over the next 50 Years", Expert Meeting on How to feed the World in 2050, Food and Agriculture Organization of the United Nations, Economic and Social Development Department, 2009, pages 1-8.

Hoekman, B. M. Maskus, K.E. and Saggi, K. (2004). "Transfer of technology to developing countries: unilateral and multilateral policy option", Policy Research Working Paper Series 3332, The World Bank, pages 2-19.

Hoffman, K. and Rush, H. (1988). Micro-electronics and Clothing, Praeger, New York, pages 120-181.

Holland, J. and Campbell, J. (2005). Methods in development research: combining qualitative and quantitative approaches, First Edition, Centre for Development Studies, University of Swansea, ISBN 1 85339 5722, pages 183-188.

Http://www.umeme.co.ug/index.php?page=ODI=

IADB (2004). "The Emergence of China: Opportunities and Challenges for Latin America and the Caribbean", Washington, D.C, pages 1-5.

IFPRI (2011)."Transforming African Economies - Factsheet on Uganda", Policy brief. 2033 Washington, DC 20006-1002 USA http://www.ifpri.org/publication/transforming-african-economies-factsheet-uganda.

IMF (2010)."Uganda: Poverty reduction strategy paper", IMF Country Report No. 10/141, IMF publication services.

International Labour Organisation (2002). "Decent work and the informal economy", Report VI, International Labour Conference, 90th Session 2002, (Geneva).

Jensen, M.B., Johnson, B., Lorenz, E. and Lundvall, B.-Å. (2007). "Forms of knowledge and modes of innovation", Research Policy, Vol. 36, No. 5, pages 680-693.

Jin, Z. (2005). Global technological change from hard technology to soft technology, first edition, ISBN 1-8415-124-7, published by Intellect limited, pages 16-17.

Johnson, B, and Lundvall, B-Å. (2001). "Why all this fuss about codified and tacit knowledge?" paper presented at the DRUID Winter Conference, Korsør, Denmark, January 18-20.

Kamau, P., Michuki, G., Gatimu, C. and McCormick, D. (2012). "Adjusting to Chinese Ascendancy in the Post-MFA Global Clothing Industry: The Case of Kenya". Research Report. Nairobi: University of Nairobi, Institute for Development Studies. Available on www.acfrn.uonbi.ac.ke/.

Kaplinsky, R. (1990). The Economies of Small: Appropriate technology in a changing world, IT Publications in association with Appropriate Technology International, pages 1-35.

Kaplinsky, R. (2010). "Schumacher meets Schumpeter: Appropriate technology below the radar", IKD Working Paper, Development Policy and Practice: Milton Keynes: Open University, pages 1-16.

Kaplinsky, R. (2011)."Bottom of the pyramid innovation and Pro-Poor Growth", IKD Working Paper No. 62, pages 2-17. www.open.ac.uk/ikd/publications/working-papers.

Kaplinsky, R. and Morris, M. (2008). "Do the Asian Drivers Undermine Export-Oriented Industrialisation in SSA", World Development Special Issue on Asian Drivers and their Impact on Developing Countries, Vol. 36, No. 2, pages 254–273.

Kaplinsky, R. and Messner, D. (2008). "The impact of Asian Drivers on the developing world", World Development Vol. 36, No. 2, pages 197–209.

Kasmire, J., Dijkema, G.P.J. and Nikolic, I. (2012). "Diffusion: Key to Horticulture Innovation Systems", CESUN 2012: 3rd International Engineering Systems Symposium, Delft University of Technology, The Netherlands, pages 1-8.

Kennan, J. and Stevens, C. (2005). "Opening the Package: the Asian Drivers and Poor-Country Trade", IDS, pages 8-14, 2005.

Kennedy, C. (1964). "Induced bias in innovation and the Theory of distribution", Economic Journal 37, pages 541-547.

Kim, L. (1998). "Crisis construction and organizational learning: Capability building in catching-up at Hyundai Motor", Organization Science, 9(4), pages 506–521.

Kitching, G. (1982). Development and underdevelopment in historical perspective: populism, nationalism and industrialization, 1st Edition, ISBN 0 416 73130 9, Methuen and Co, pages 94-98.

Lall, S. and Weiss, J. (2004). "People's Republic of China's Competitive Threat to Latin America: An analysis for 1990-2002", ADB Institute Discussion Paper No. 14, October 2004, Tokyo.

Lamming, R. C. (1993). "Beyond partnership - Strategies for innovation and lean supply", Prentice Hall, Hemel Hemstead, 1993, ISBN: 0 13 143785 2, pages 299

Lambert, B. and Giles, M. (2014), "Sino-African encounters in Ghana and Nigeria: from conflict to conviviality and mutual benefit", Journal of Current Chinese Affairs, 43(1), pages 9–39.

Lancaster, K. J. (1966). "Change and Innovation in the Technology of Consumption", American Economic Review, Vol. 56, No. 1/2, pages 14-23.

Lee J-Y. and Mansfield, E. (1996). "Intellectual Property Protection and U.S Foreign Direct Investment" The review of Economic and Statistics Vol. LXXXVIII Number 2, pages 181-186.

Levin H. M., Jamison, D. T. and Radner, R. (1976). "Concepts of Economic Efficiency and Educational Production", in Froomkin, J. T. Jamison D. T. and Radner, R. (Eds), Education as an Industry, NBER Volume ISBN: 0-88410-476-1, pages 149 – 198.

Levy, P.S. and Lemeshow, S. (2008), "Sampling of Populations: Methods and Applications", John Wiley and Sons Inc, fourth edition, United States of America, pages 150-213.

Li-Hua, R. (2006). "Examining the Appropriateness and Effectiveness of Technology Transfer in China", Journal of Technology Transfer in China, 1 (2), pages 208-223. http://dx.doi.org/101108/17468770610670992.

Liu, Z. (2006). "Foreign direct investment and technology spillovers: Theory and evidence", Journal of Development Economics, 85, pages 176–193. www.elsevier.com/locate/econbase.

Lundvall, B-Å and Johnson, B. (1994) "The learning economy", Journal of Industry Studies, 1, pages 23-42.

Mallet, V. (2008). "The Rebalance of Power", Financial Times, April 5, 2008, pages 7.

Mansfield, E. and Romeo, A. (1980). "Technology Transfer to Overseas Subsidiaries by U.S.- D.C.: Volunteers in Technical Assistance", Quarterly Journal of Economics 95(4), pages 737-750.

Mansfield, E. (1968). The Economics of Technology Change, 1st Edition, W. Norton, New York, pages 10-45.

Mansfield, E. (1994). "Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer", International Finance Corporation Discussion Paper No. 19, World Bank, Washington, DC, pages 2-19.

Markusen, J. R. (1995). "The Boundaries of Multinational Enterprises and the Theory of International Trade", Journal of Economic Perspectives 9: pages 169-190.

Maskus K.E. (2004). "Encouraging International Technology Transfer", an UNCTAD ICTSD Projection International Property Rights and Sustainable Development, Issue Paper No.7, pages 9-27.

Matisko, K. (2012). "Navigating Uganda's economy through five decades", a published article in The Ugandan Daily Monitor, a leading news paper in Uganda, October 9, 2012. http://www.monitor.co.ug/Business/Prosper/Navigating-Uganda-s-economy-through-five-decades/-/688616/1528684/-/item/0/-/pad7tm/-/index.html.

Mawejje, J. and Nampewo, D. (2012). "Perceptions of Ugandan Business Executives on the Current and Expected Business Economic Conditions", Issue 1 of the Uganda Business Climate Index, published by Economic Policy Research Centre- University of Makerere, pages 1-4.

Mawejje, J., Munyambonera, E. and Bategeka, L. (2013). "Powering Ahead: The Reform of the Electricity Sector in Uganda", Journal of Energy and Environment Research; Vol. 3, No. 2; 2013, ISSN 1927-0569 E-ISSN 1927-0577, pages 136 Published by Canadian Centre of Science and Education.

McNamara, K. (2008). The Global Textile and Garments Industry: The Role of Information and Communication Technologies (ICTs) in Exploiting the Value Chain, 1st Edition, An *info*Dev publication, pages 1-18.

Milner, C., Morrissey, O. and Rudaheranwa, N. (2013). "Protection, Trade Policy and Transport Costs: Effective Taxation of Ugandan Exporters", Centre for Research in Economic Development and International Trade, University of Nottingham, DFID-TERP: Credit Discussion paper 7 (CDP007), pages 2-14.

Mokyr, J. (2003). "Thinking about Technology and Institutions", paper presented at the Macalester International College Roundtable, pages 3-7.

Moncrieffe, J. (2004). "Uganda's Political Economy: A Synthesis of major thought", A Report Prepared for DfiD Uganda February 2004, pages 14-38.

Morawetz, D. (1974), "Employment implication on industrialization in developing countries: A survey", An International Bank for Reconstruction and Development, Bank Staff Working Paper No. 170, pages 1-45

Morris, M and G. Einhorn, (2008), "Globalisation, welfare and competitiveness: the impacts of Chinese imports on the South African clothing and textile industry", Journal of Competition and Change, Vol. 12, No. 4, 2008, pages 355-376.

Morris, M. and Barnes, J. (2009). "Globalization, the Changed Global Dynamics of the Clothing and Textile Value Chains and the Impact on Sub-Saharan Africa", Research and Statistics Branch, working paper No. 10/2008, UNIDO Vienna, pages 1-27.

Morris, M., Staritz, C. and Barnes, J. (2011). "Value Chain Dynamics, Local Embeddedness, and Upgrading in the Clothing Sectors of Lesotho and Swaziland", International Journal of Technological Learning, Innovation, and Development, pages 2-15.

Morrissey O. and Rudaheranwa N. (2012). "Uganda trade policy and export performance in the 1990s", Centre for Research in Economic Development and International Trade, University of Nottingham, DFID-TERP: Credit Discussion Paper No. 98/12, pages 6-28.

Mutambi, J. (2008). "Advancing value addition and competitiveness through standardization to promote manufacturing sector", Proceedings of the Annual International Standards Conference (AISC) 10th – 12th June 2008, Kampala- Uganda, pages 2-11.

Mutambi, J., Byaruhanga, J.B. and Trojer, L. (2013). "Promoting Innovation and Entrepreneurship in Rural Communities: Case of OVOP Program in Uganda", (Part of the paper that is in the proceedings of the 7th International OVOP Seminar 13th-14th December 2010, Hanoi, Vietnam and submitted to the AJSTID for publication), pages 5-19.

Mutibwa, P. M. (1992). Uganda since independence: a story of unfulfilled hopes, United Kingdom: C. Hurst & Co. ISBN 1-85065-066-7, pages 65–70.

Naluwairo, R. (2011). "Promoting agriculture sector growth and development: a Comparative Analysis of Uganda's Political Party Manifestos (2011-2016)", ACODE Policy Research Series, 41, 2011, Kampala, pages 3-4.

Narayanan, V.K. (2013). Managing technology and innovation for competitive advantage, published by Dorling Kindersley (India) PvT Ltd, licenses of Pearson Education in South Asia, pages 4-47.

Nelson, R.R. and Winter, S.G. (1982). "An evolutionary theory of economic change", a library of congress cataloguing in publication data, Harvard University, ISBN 0-674-27228-5 (paper), pages 72-85.

Nicholson, M. (2002). "Intellectual Property Rights and International Technology Transfer: The Impact of Industry Characteristics", U.S. Federal Trade Commission, manuscript, pages 2-17.

Nkwi, P., Nyamongo, I. and Ryan G. (2001). "Field research into socio-cultural issues: Methodological guidelines", Yaoundé, Cameroon: International Center for Applied Social Sciences, Research, and Training/UNFPA, pages. 4-21.

Nordin, S. Mohd, N. and Saad, M. (2014). "Innovation Diffusion of New Technologies in the Malaysian Paddy Fertilizer Industry", Procedia-Social and Behavioural Sciences, Volume 109, 2nd World Conference on Business, Economics and Management, pages 768-778.

NTMP (2009), "The National Transport Master Plan of Uganda", A government of Uganda policy document, pages 2-19.

Obwona, M., Shinyekwa, I., Kiiza, J. and Hisali, E. (2013). "The evolution of industry in Uganda", This paper was prepared under the joint UNU-WIDER/Brookings Institution project Learning-to-compete project, pages 4-16.

OECD (1976), Appropriate technology: Problems and promises, Paris, OECD

OECD (2013), "OECD Fact book 2013: Economic, Environmental and Social Statistics", http://www.oecd-ilibrary.org/sites/factbook-2013 en/04/02/01/index.html?itemId=/content/chapter/factbook-2013-34-en.

OECD/WTO/IDE-JETRO, (2013). "Aid for Trade and Value Chains in Textiles and Apparel", a joint report by OECD, WTO, and IDE-JETRO.

Okuku, J. A. (2006). "Informing Industrial Policy in Uganda: Interaction between Institutions, Technology and Market Reforms", A PhD Thesis Submitted to the Graduate School of Public and Development Management at University of the Witwatersrand, pages 222-260.

Othieno, L. and Nampewo, D. (2012). "Opportunities, Challenges and Way Forward for Uganda's Trade" in Education services within the East African Community, Research Series No. 93, pages 3.

Othieno, L. and Shinyekwa, I. (2011). "Trade, Revenue and Welfare Effects of the East African Community Customs Union principle of asymmetry on Uganda: an application of WITS-Smart Simulation Model", Economic Policy Research Centre (EPRC), Kampala-Uganda, pages 19-20.

Pack, H. (1981). "The choice of technique and development in textile in industry", in A. Bhalla (Ed), Towards Global Action for Appropriate Technology, Geneva, ILO, (3rd Edition), ISBN 92-2-103969-2. pages 159-178.

Pearson, R. (2000). "Moving the Goalposts: Gender and Globalisation in the Twenty-first Century", Gender and Development, Vol. 8, No.1. pages 10-19.

Pearson, R. (2003). "Feminist responses to economic globalisation: some examples of past and future", in Kerr J. and Sweetman C. (Eds), Women Reinventing Globalisation, Information Press, Eynsham, Oxfam GB, ISBN 0 88598 492 9, pages 25-34.

Peres, R., Muller, E. and Mahajan, V. (2010). "Innovation diffusion and new product growth: a critical review and research directions", International Journal of Research in Marketing, 27, pages 91-206.

Perrett, G.B. and Jeffery, W. (1922). Ether and theory of relativity, this is a translation of 'A'ther und relativit'a'tstheorie (Berlin: Springer, 1920). Meyerson cities L'ȅtheretal thȅorie de la relativitȅ, trans solovine (Paris: Gauthiȅr, 1921).

Polanyi, M. (1966). The Tacit Dimension, Doubleday, Garden City, NY, pages. 7-34.

Prahalad, C. K. and Hammond, A. (2002). "Serving the World's Poor Profitably", Harvard Business Review, September, pages 4-11.

Prahalad, C.K. (2005). The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits, Pearson Education/Wharton School Publishing, Upper Saddle River, NJ, pages 15-61.

Ramanathan, K. (2009). "An overview of technology transfer and technology transfer models", a paper prepared for the Asian and Pacific Centre for transfer of technology (APCTT), pages 3-10, www.technology 4sme.net.

Ranganathan, R., and Foster V. (2012). "Uganda's Infrastructure a Continental Perspective", World Bank Africa Region Sustainable Development Department, Policy Research Working Paper 5963, pages 3-20.

Ranja, T. (2003). "Success Under Duress: A comparison of Indigenous Africans and East African Asian Entrepreneurs", Economic and Social Research Foundation Working paper series on Globalisation and East Africa, 7, pages.12.

Rogale D., Petrunić, I., Dragčević, Z. and Rogale, S. F. (2005). "Equipment and methods used to investigate energy processing parameters of sewing technology operations", International Journal of Clothing Science and Technology, Vol. 17 Issue: 3/4, pages 179 – 187.

Rogers, E.M. (2003). Diffusion of innovation, 5th Edition, A Division of Macmillan Publishing Co, pages 5-45.

Rogers, E.M. and Kinciad, D.L. (1981). Communication networks: a new paradigm for research, New York: Free Press, pages 21-46.

Rosenberg, N. (1996). "Uncertainty and technological change", in Landau, R., Taylor, R., and Wright, G. (Ed). The Mosaic of Economic Growth, Stanford University Press, Stanford CA, pages 91-109.

Rubery, J., Hebson, G., Grimshaw, D., Carroll, M., Smith, L., Marchington, L. and Ugarte, S. (2011), The recruitment and retention of a care workforce for older people, Manchester University of Manchester, pages 4-16.

Rudaheranwa, N. (2009). "Trade policy and transport costs in Uganda", CREDIT Research Paper, No. 06/09, pages 6-18.

Ruttan, V. (2001). Technology, Growth and Development: An Induced Innovation Perspective, Oxford University Press, ISBN13:978095118711, pages 8-21.

Sahal, D. (1981). "Alternative conceptions of technology", Research policy paper 10, pages 2–24.

Sahal, D. (1982). "The form of technology". in Sahal, D. (Ed)., The Transfer and Utilization of Technical Knowledge, Lexington Publishing, Lexington, MA, pages 125–139.

Sahin, I. (2006). "Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology-Related Studies based on Rogers' Theory" The Turkish Online Journal of Educational Technology, 5 (2), page 14–23.

Scheuren, F. (2004). “What is a Survey”, Paper written from the 1980 Article, USA, pages 9-21.

Schmookler, J. (1962). “Changes in Industry and in the State of Knowledge as Determinants of Industrial Invention”, National Bureau of Economic Research, the Rate and Direction of Inventive Activity, Princeton: Princeton University Press: pages 195-232.

Schmookler, J. (1966). Invention and Economic Growth, Harvard University Press, pages 30-61.

Schumacher, F. (1973). Small is Beautiful, Blond and Briggs, London Sciences, Chicago: Rand McNally, pages 10-71.

Shinyekwa, I. and Mawejje, J. (2013). “Macroeconomic and Sectoral Effects of the EAC Regional Integration on Uganda: A Recursive Computable General Equilibrium Analysis”, Economic Policy Research Centre, Makerere University, pages 11-24.

Shoffner, M.B., Jones, M. and Harmon, S. W. (2000). “Paradigms Restrained: Implications of New and Emerging Technologies for Learning and Cognition”, Volume 6, Issue 1: New Information Technology and Liberal Education, http://dx.doi.org/10.3998/3336451.0006.111.

Siggel E. and Ssemogerere G. (undated). “Uganda’s Policy Reforms, Industry Competitiveness and Regional Integration: a comparison with Kenya” an Equity and Growth through Economic Research (EAGER), pages 3-6.

Smith, P. J. (2001). “How Do Foreign Patent Rights Affect U.S. Exports, Affiliate Sales, and Licenses?”, Journal of International Economics 55: pages 411-439.

Solow, R.M. (1957). “Technical Change and the Aggregate Production Function”, The Review of Economics and Statistics, Vol. 39, No. 3, pages 312-320.

Solow, R.M. (1968). “Recent Controversy on the Theory of Inflation: An Eclectic view”, in S. Rousseas (Ed.), Inflation: Its Causes, Consequences, and Control, A Symposium Held by the Department of Economics, New York University, New York University, New York, pages 1-17.

Spolaore, E. and Wacziarg, R. (2011). "Long-Term Barriers to the International Diffusion of Innovations", National Bureau of Economic Research, Inc, NBER Working paper 17271, pages 15-21.

Ssewanyana, S. and Bategeka, L. (2007). “Chronic poverty and economic growth in Uganda: The role of markets”, Background Paper. Manchester, UK: Chronic Poverty Research Centre (CPRC), pages14-18.

Stewart, F. (1982). Technology and Underdevelopment, London, Macmillan, 2nd edition, pages 1-30.

Tan, H. W. and Batra, G. (1996). “Enterprise Training in Developing Countries: Overview of Incidence, Determinants, and Productivity Outcomes”, A World Bank Private Sector Development Department Occasional Paper No. 9, pages 3-20.

Teddlie, C. and Yu, F. (2007). “Mixed methods sampling: A typology with examples”, Journal of Mixed Methods Research, 1(1), pages 77-100.

Teece, D. (1977). "Technology transfer by multinational firms: the resource cost of transferring technological know-how", The Economic Journal 87, pages 242–261.

Tegegne-Gebre, E. (2006). "Asian Imports and Coping Strategies of Medium, Small and Micro Firms: The Case of Footwear Sector in Ethiopia", mimeo, pages 2-15, Addis Ababa: Addis Ababa University.

The East African Magazine (2012). "Uganda threatens to boycott Port of Mombasa over transit cash bond", September 15, 2012 edition, available on http://www.theeastafrican.co.ke/news/Uganda+transit+fees

Tikri, T. and Faye, I. (2013). Financial Inclusion in Africa, 1st Edition, an African Development Bank publication, ISBN: 978-9938-882-19-3, pages 46.

Thoburn, J. (2009). "Vietnam as a Role Model for Development", United Nations World Institute for Development Economics Research [WIDER], Helsinki, Research Paper 2009/30, pages. 1-12. Available on www.wider.unu.edu/publications/working-papers/research-papers/en_GB/research-papers/.

Tumuhairwe, C. (2012). The effect of Idi Amin's expulsion of the Asian community in Uganda on the social and economic development of the country, a Maastricht School of Management working paper No. 2012/37, pages 3-4.

Uganda MDG Report (2013). "Millennium Development Goals Report for Uganda 2013", A report prepared by the Ministry of Finance, Planning and Economic Development September 2013, New Vision Printing and Publication Limited, pages 1-5.

UIA (2013). "Uganda Investment Authority's performance in the financial year 2010/11", a press briefing by the Uganda minister of finance, pages 1-2.

UNCTAD (2003). "Africa's Technology Gap: a case study on Kenya, Ghana, Uganda and Tanzania", UNCTAD/ITE/IPC/Misc.13, a United Nations publications, pages 15-27.

UNCTAD (2013). "The way to the Ocean: Transit corridors servicing the trade of landlocked developing countries", a Technical report by the UNCTAD secretariat, pages 11-31.

UNCTAD (2013). "Science, technology and innovation capability gaps, policy environment, and evolving policy tools for sustainable development", paper presented at the multi-year Expert Meeting on Investment, Innovation and Entrepreneurship for Productive Capacity-building and Sustainable Development, Second session, Geneva, 17–21 March 2014, UNCTAD secretariat TD/B/C.II/MEM.4/5, pages 9-23.

UNCTAD, (2010). "Foreign direct investment, the transfer and diffusion of technology, and sustainable development", an expert meeting on the contribution of foreign direct investment to the transfer and diffusion of technology and know-how for sustainable development in developing countries: especially least developed countries, Geneva, 16–18 February 2011, Item 3 of the provisional agenda, TD/B/C.II/EM.2/2, pages 1-18.

UNIDO, (2007). "Industrial development: analysing competitiveness, growth potentials and investment opportunities", United Nations, Vienna, pages 2-31.

United States Congress (1993). "Industrial Energy Efficiency, Office of Technology Assessment", OTA-E-560 (Washington, DC: U.S. Government Printing Office), pages 6-11.

UNU-WIDER (2008). "World Income Inequality Database (WIID)", Accessed on 10 March 2011; available at: www.wider.unu.edu/wiid.

USAID (1976), "Section 107 proposal for a programme in appropriate technology", Washington, presented at the 25th congress of the USA, pages 1-50.

USAID (2003). "Report on Cotton- Textile Supply Chain in Uganda", report published by USAID. Regional Agriculture Trade Expansion Support Program, pages 6-21.

Wahab, S. A., Rose, R. C. and Osman, S. I. W. (2012). "Defining the Concepts of Technology and Technology Transfer: A Literature Analysis", International Business Research, 2012, pages 61-71.

Wang, J.Y. (1990). "Growth, technology transfer, and the long-run theory of international capital movements", Journal of International Economics, Volume 29, Issues 3–4, November 1990, pages 255–271.

Wellman, B. (2001). "Physical Place and Cyber place: The Rise of Personalized Networking" in Blokland", in Talja & Mike Savage (Eds.), Networks, Class and Place, special issue of International Journal of Urban and Regional Research, 25(2, June).

WEO (2012). "World Economic outlook 2012: Growth Resuming, Dangers Remain", International Monetary Fund, International Monetary Fund, Publication Services, ISBN 978-1-61635-246-2, pages 3-21.

Whitcombe, R. and Carr, M. (1982). "Appropriate technology institutions: a review", Occasional paper No. 7, London Intermediate Technology publications, 1982, pages 1-16.

Willoughby, K. W. (1990), Technology choice: A critique of the appropriate technology movement, West view Press Boulder & London, pages 7-22.

Woodhouse, P. (1998). "People as Informants" in Thomas, A. et al (Eds), Finding out Fast: Investigative Skills for Policy and Development, UK: The Open University, pages 127-146.

World Bank (1976). "Appropriate technology in World Bank activities", Washington, page 5.

World Bank (2006). "Uganda - Enterprise Survey 2006", a World Bank publication, pages 11-27.

World Bank (2011), "World Development Indicators (WDI)", Accessed on 10 March 2011; http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2.

World Bank (2013), Doing Business 2013: Smarter Regulations for Small and Medium-Size Enterprises, 10th Edition, International Bank for Reconstruction and Development, pages 3-21.

Wright, S. (2001). "Sewing machine maintenance", New Mexico State University, cooperative Extension Service, College of Agriculture and Home Economics, Guide C-102, http://aces.nmsu.edu/pubs/_c/C102/.

www.asiandrivers.open.ac.uk/.

Zafar, A. (2007). "The Growing Relationship between China and SSA: Macroeconomic, Trade, Investment and Aid Links." World Bank Research Observer 22(1): pages 103-130.

Zhou, Y. and Lall, S. (2005). "The impact of China's FDI surge on FDI in South-East Asia: panel data analysis for 1986-2001", Transnational Corporations, vol. 14, no. 1, pages 1-25.

APPENDICES

Appendix I: Questionnaire for machine importers and distributors

1	Name of Respondent		
3	Name of respondent		
4	Gender	Male	[ ]
		Female	[ ]
5	Nationality		
6	What is your highest level of education?	None	[ ]
		Primary	[ ]
		Sec/Voc	[ ]
		Tertiary	[ ]
		Other....................	
7	Position of Respondent	Managers/Senior staff	[ ]
		Junior Staff	[ ]
		Others	
8	Do you transact your business as a/an	Importer	[ ]
		Distributor	[ ]
		Both	[ ]
		Others	
9	How many years/months have you been working as an importer/distributor?	Less than 1 year	[ ]
		Between 5 and 10 years	[ ]
		Above 10 years	[ ]
10	Business Overview		
11	Location of organisation		
12	Is this business registered?	Yes	[ ]
		No	[ ]
13	If yes to , was the business registered?	....	
14	If no to 9, then what is the country of origin of the company?	....	
15	Mechanism/Mode of entry		
16	List the type(s) and origin of garments and textiles capital equipment you (your organisation) import/distribute in Uganda.		
	Description of Equipment	*Made in*	
I			
II			
III			
IV			

V			
17	Why do you import/distribute this/these type(s) of capital equipment described above from the country of origin specified?		
18	By what means is/are capital equipment transported directly from its country of origin to Uganda?	By sea	[ ]
		By air	[ ]
		By road	[ ]
		Unapproved roots	[ ]
		Others	
19	What is the duration for importing capital equipment directly from its country of origin to Uganda?	Less than a month	[ ]
		One month	[ ]
		More than a month	[ ]
		1 year	[ ]
20	Does your capital equipment go through a transit point?	Yes	[ ]
		No	[ ]
21	If yes to 16, what is the duration for importing the capital equipment to Uganda?	....	
22	If yes to 16, please describe how the capital equipment is transported.	....	
23	By what means is/are capital equipment transported to your customers within Uganda?	by water	[ ]
		by air	[ ]
		by road	[ ]
		unapproved roots	[ ]
		Others (please specify)	
24	Please describe your customers.	Retailers	[ ]
		Wholesalers	[ ]
		Tailors and Seamstresses	[ ]
		Others (please specify)	
25	Which part of Uganda is/are your customers located?		
26	On the average how many customers do you distribute the capital equipment to in each location?		
27	What maximum distance do you have to travel to distribute the capital equipment to your customers?		
28	On the average how long does it take to complete the distribution of an imported set of capital equipment in Uganda?		
29	What is your profit margin when you import/distribute capital equipment made in	China or India	

		Japan	
		USA	
30	What challenge(s) do you encounter at the ports and during the distribution of the capital goods in Uganda?		
	Challenges encountered at the port		
	Challenges encountered in distribution		
31	How do your customers receive information on the capital equipment you import/ distribute?	Through advertisement	[ ]
		Through various associations (dressmakers and tailors association etc)	[ ]
		through their friends	[ ]
		through a distributor or importer	[ ]
		Other………………	
32	Do you have competitors who also deal in the distribution of the same capital equipment in your customers' location?	Yes	[ ]
		No	[ ]
33	What percentage of your total capital investment cost goes into payment of capital equipment import duty at the ports?	......................%	
34	How does the tariff regime impact on capital goods imports into garments and textiles sub-sector in Uganda		

Appendix II: Questionnaire for machine operators at the small and large scale levels

A. Overview and History of the business.

1. Name of organization………
2. Location of organization ……………
3. When did you establish this business?…………..
4. How did you get into this business?…………
5. Is this firm registered? (if registered, Formal and if not then informal)
   [ ] Yes [ ] No
6. When was the firm registered?..............
7. What manufacturing activity do you undertake?
   [ ] Ginning
   [ ] Milling
   [ ] Knitting

[ ] Sewing
[ ] Others (please specify).........

8. What is the nature of ownership of your organization?
   [ ] State Owned
   [ ] Public listed
   [ ] Foreign Ownership
   [ ] Locally owned
   [ ] Public Private Partnership
   Others (please specify).............................

9. What is your country of origin?
   [ ] Japan
   [ ] India
   [ ] China
   [ ] United States of America
   [ ] Germany
   Other (Please specify)..

10. Why did you establish this business (in Uganda for foreigners)?....................
.

11. How many people are employed in this business? ....

12. Are you self-employed
   [ ] Yes [ ] No

13. If no to 12, are you employed by someone to manage this enterprise?
   [ ] Yes [ ] No

14. Are you a full time worker?
   [ ] Yes [ ] No

15. If no to 14, then what other job do you undertake?...........

16. How many workers are full-time workers?...........
   [ ] Yes [ ] No

17. How many are part-time workers?...........

18. Do you undertake any other business apart from this business?
   [ ] Yes [ ] No

19. If yes, what proportion (%) of your total income do you earn from this business?

B. Overview of Capital equipment

20. What is the origin of your equipment?
   [ ] Japan
   [ ] China
   [ ] India
   [ ] Germany
   [ ] Austria
   [ ] England
   Other(s) (Specify)..

21. How many of the equipment comes from

Country	Count	%

China	---------	--------
Japan	---------	--------
India	---------	--------
Germany	---------	--------
Austria	---------	--------
Other *(please specify)*	---------	--------

22. Which year did you acquire this machine?

    ....

23. Did you purchase the equipment brand new?
    [ ] Yes [ ] No

24. What proportion of your equipment was bought brand new?

Equipment Name	**Origin**	**No**	**%**	**Year**
---------------------------------	------------	--------	---------	-------
---------------------------------	------------	--------	---------	-------

25. Did the origin of the equipment inform your choice of this equipment?
    [ ] Yes [ ] No

26. What other factor motivated you to go for this equipment?

27. What was the cost of the equipment at the time you bought it?............................UGX

28. List the top 3 most important equipment in your organization.

29. On a scale of 1-7, how will grade current rate of work as compared to when you bought your machine?

30. If you are to purchase this particular equipment today, how much will it cost?............UGX

31. How regular do you replace this equipment?..

32. Why do you replace this equipment? ....

33. Did you replace it with a second hand or brand new equip?..............................

34. What is the monthly cost of running this equipment?..................................UGX

35. How long can it take you to finish sewing a ‘kitenge shirt’ using this equipment?

36. Does this equipment aid you in completing the dress sewing early?
[ ] Yes [ ] No

C. Machine breakdown, repairs and availability of parts

37. What is the main cause of breakdown of this machine?

Equip 1:	Equip 2:	Equip 3:

38. On the average, how many times does your equipment breakdown per year?...........

Equip 1:	Equip 2:	Equip 3:

39. On the average, how much do you spend on this equipment anytime it breaks down?...UGX

Equip 1:	Equip 2:	Equip 3:

40. Are spare parts readily available for this/these equipment in Uganda?

Equip 1: [ ] Yes [ ] No	Equip 2: [ ] Yes [ ] No	Equip 3: [ ] Yes [ ] No

41. If yes to 42, where does this spare part originate from?
[ ] China
[ ] India
[ ] Japan
[ ] England
[ ] Germany
Other (Please specify)...................................

42. What is the maximum amount of money you spend on purchasing a spare part for each equipment?

Equip 1.............................UGX	Equip 2............................UGX	Equip 3..........................UGX

43. What minimum amount of money do you spend on each of the equipment?

44. Do you have local repairers who can repair this equipment should it breakdown?
[ ] Yes [ ] No

45. Do you sometimes require expatriates to repair this equipment?
[ ] Yes [ ] No

46. If yes, where do they originate from?
[ ] China
[ ] India
[ ] Japan

[ ] England
[ ] Germany
Other (Please specify)..

47. On a scale of 1 to 7, please grade availability and accessibility of spare parts. (Likert Scale)

48. On a scale of 1 to 7, to what extent can you measure the level of durability of the spare parts from China (Likert Scale)?

49. Maximum number of hours that the equipment/machine can operate daily. .....hours

50. Do you have an upgrade plan for the Capital Equipment?
[ ] Yes [ ] No

51. Do you use power?

D. Power/Fuel Requirements

52. What is the main source(s) of power for this equipment?
[ ] Electricity
[ ] Diesel
[ ] Battery
[ ] Gas
[ ] Manually Powered
Others please specify..................................

53. How much do you pay for power monthly?.................UGX

54. Do you have regular supply of power?
[ ] Yes [ ] No

55. On the average what proportion (%) of your production cost goes into power?........%

56. How much of money were you paying for power when you first bought this equipment?............UGX

57. How much are you paying now for power?............................UGX

58. Does aging of this equipment cause power needs of this equipment to increase?
[ ] Yes [ ] No

59. By what margin (%) does this equipment contribute in the rise of power cost?.................%

60. How many litres of petrol/diesel (possibly number of batteries) do you require for this equipment/machine when it was new and now?...........

61. What is the cost of lubricants/or oil per month?...................UGX

E. Labour

62. Do you require any specialised type(s) of skill/training to operate this machine?

[ ] Yes
[ ] No

63. How many people are required to operate this equipment at a given time?......................

64. Are there local repairers available to repair this equipment when it breakdown?
[ ] Yes
[ ] No

65. What is the monthly cost of skilled (workers who have received some form of training, either on job training or through formal education) labour required for this equipment?......................................UGX

66. What is the monthly cost of unskilled labour?.. UGX

67. On a scale of 1-7, to what extent do you get information on the machines from your superiors?............................

F. Output

68. What is the name of the product you produce?..

69. What Quantity of the output do you produced per day?...............................

70. What Percentage of output goes waste?... %

71. What is the unit price of your output produced? ....UGX

72. How long (hours) does it take to produce a unit of output? ....hour(s)

73. On the average, how many portions of your daily revenue do you take home as your daily income if you divide your daily revenue into 100 portions?..................

74. What is the most important factor that influences the type of design and pattern you make on a fabric?.................................

G. Environmental and Health issues

75. How do you manage the waste that comes out of this equipment?

76. Does this equipment emit gases or any substance that may be inimical to the environment?
[ ] Yes [ ] No

77. If yes to (2) on a scale of 1-7, how will you grade the level of gases this equipment emit?

78. Does this equipment make a lot of noise during operation?

79. If yes to (4) on a scale of 1-7, how will you grade the level of noise this equipment make?

80. Do you or any of your colleagues complain of health issues as a result of using this equipment?

81. If yes to (6) on a scale of 1-7, how will you grade the level of health challenges poses to you?

82. Does this equipment produce excessive heat that can be challenging to your health?

83. If yes to (8) on a scale of 1-7, how will you grade the level of heat produced by this equipment?

H. Perception on AD economies and their equipment

84. Do you have any idea about China and India?
…………………………………………………………………………

85. Have you heard anything about those countries (China and India) before?
[ ] Yes [ ] No

86. If yes tell us about those countries..........

87. How is this Chinese and Indian presence in Uganda affecting economic activities in the country? Please explain……..

88. How have the Chinese and Indians impacted on your everyday economic activities? E.g. trading, production etc.
[ ] Positively
[ ] Negatively
[ ] Unchanged

Please Explain…………

89. What is/are the impact of the presence of the Asian Drivers in the garments and textiles sector in Uganda in the context of

Growth in the garment...............…………….
Employment………………………………………
Poverty reduction ………..........……………….
Technology transfer. ……………………..........

I. Likert Scale

90. On a scale of 1-7, give your preference level on the following indicators about the equipment you are using. (in ascending order)

	Western(Including Japan)								**China and India**						
Indicators	→								→						
Equipment 1:	1	2	3	4	5	6	7		1	2	3	4	5	6	7
Price															
Quality															
Skip stitches (sewing machines)															
Needle breaks (sewing machines)															
Durability															
Quantity of output															

Level of Capacity Required															
Amount of Power/Energy															
Reparability of Equipment															
Maintenance and repair cost															
Reliability of Equipment															
Requires highly built Infrastructure															
percentage of Waste															
Labour Intensity															

J. Evolution of Preference of AD Capital Equip

93. Since exposure to AD equipment your demand has:

Increased [ ] Unchanged [ ] Decrease [ ] Unknown [ ]

94. If income doubles demand for AD equipment in the G&T sector will

[ ] Increase

[ ] Unchanged

[ ] Decrease

[ ] Unknown

95. If your income declines demand for AD equipment will

[ ] Increase

[ ] Unchanged

[ ] Decrease

[ ] Unknown

K. Extent of Penetration

96. Who did you buy this equipment from?
[ ] Purchased from a market dealer
[ ] A joint venture partner provides them
[ ] Parent company of the firm provide them
[ ] Another firm purchased them
Others (specify)……………………………………………………………………………

97. What is name of the District and location where you purchased this equipment?………………………

98. Mention any other locality and district in Uganda where you think this equipment is sold.

Name of locality	**District**

99. What is the origin of the person/organization that sold the equipment for you the locality you mentioned above?

100. How far did you have to travel before getting this equipment to purchase? ....km

101. On a scale of 1-7, to what extent can you say you use Chinese equipment?

102. On a scale of 1-7, to what extent can you say you use equipment from the Western countries (including Japan)?

103. What challenges do you encounter when you make the effort to buy this equipment?........................

104. What distances do you have to travel before getting a spare part for this equipment?.......km

L. Mechanism of Transfer

105. Where did you buy this equipment in Uganda?

106. How and who transported this equipment to you?

107. What was the mode of payment for the equipment?

[ ] On credit

[ ] Outright purchase

[ ] Through various working associations

[ ] Third Party

Other (specify)...

108. Do you know about the person/institution who imported the equipment?

[ ] Yes [ ] No

109. If yes, please describe them......

110. To what extent will you say you get informed about the equipment before purchasing by the following ways (Likert Scale)(Intensity in ascending order please ***Tick***):

	1	2	3	4	5	6	7
Advertisement							
Associations (e.g. cooperatives and clusters)							
Major Customer (Lead Customers)							
Distributors							
Employees							
A competitor firm							
Friends / Family							

Appendix III: Questionnaire for key informants in MDAs, academic institutions, associations

1	Name of Organisation..
2	Location of Organisation..
3	Name of Respondent...
4	Position in Organisation..
5	Years of experience..
6	Is your organisation involved in policy formulation in Uganda? [ ] Yes [ ] No
7	If yes to 6, what type of polic(ies) does your organisation formulate for Uganda?..........
8	Please describe the polic(ies) your organisation formulate for Uganda?
9	How does this polic(ies) influence the garments and textiles sub-sector in Uganda?
10	Please give me an overview of the tariff regime in Uganda.
11	How does this tariff regime affect the importation of garments and textiles in Uganda?
12	How does this tariff regime affect the importation of garments and textiles equipment in Uganda?
13	Does the tariff regime affect the price of the garments and textiles in Uganda? [ ] Yes [ ] No
14	If yes to 14, how does the tariff regime affect the price of garments and textiles in Uganda? ....
15	If no to 14, then explain why there is no impact on the garments and textiles sector in Uganda? ....
16	Does the tariff regime affect the price of the garments and textiles in Uganda? [ ] Yes [ ] No
17	If yes to 17, how does the tariff regime affect the price of garments and textiles sub-sector in Uganda? ....
18	If No to 17, then please explain.........................
19	What is the country of origin of garments and textiles equipment into Uganda? [ ] Uganda [ ] India [ ] China [ ] Great Britain [ ] Germany [ ] Others Please specify...
20	Does the country of origin of garments and textiles equipment influence importers to import from those countries into Uganda? [ ] Yes No [ ]
21	If yes to 20, please explain.................

22	If No to 20, please explain...............
23	What is the country of origin of garments and textiles equipment importers into Uganda? [ ] Uganda [ ] India [ ] China [ ] Great Britain [ ] Germany [ ] Others Please specify...
24	What are some of the challenges these importers encounter in the importation of garments and textiles into Uganda?...................................
25	What are some of the challenges these importers encounter in the importation of garments and textiles equipment into Uganda?....................................
26	Is there any programme or policy regarding the manufacturing of equipment in the garments and textiles sub-sector? [ ] Yes [ ] No *(if No skip to 30)*
27	If yes, how many people have been trained under such a programme?................ ....
28	Is the programme subsidised by the government? [ ] Yes [ ] No
29	Which institution is in charge of such programmes?......................... ....
30	Do rely on expatriates for such training programmes?................
31	Is there any other programme tailored towards imports substitution of capital equipment in the garments and textiles sub-sector? ....
32	What is your perception on the Asians Drivers (China and India)?
33	How important are they to the Ugandan economy? (In terms of poverty reduction, job creation, growth, income distribution, technology transfer etc?
34	How different is capital equipment from the Asian Drivers and those from Western economies? Use a scale of 1 to 7 to rank them in terms of Price, Durability of Equipment, Output Quantity, Output Quality, Energy efficiency, Technology Transfer, Number of Labour required, etc)

Appendix IV: Interview guide for machine repairers:

Machine breakdown, repairs and availability of parts

1. What is the main cause of breakdown of this machine?....................................
2. On the average, how many times does this equipment breakdown per year?................................
3. On the average, how much do you charge after repairing this equipment anytime it breaks down?..UGX
4. Are spare parts readily available for this/these equipment in Uganda?
5. What is the maximum amount of money spent on purchasing a spare part for each equipment?
6. What is the main source(s) of power for this equipment?
7. How efficient is this machine when it comes to energy consumption?
8. Do you require any specialised type(s) of skill/training to repair this machine?
9. Are there local repairers available to repair this equipment when it breakdown?

Appendix V: Ethics committee approval letter

The Open University

From	Dr Duncan Banks Chair, The Open University Human Research Ethics Committee
Email	d.banks@open.ac.uk
Extension	59198
To	David Botchie, DPP-DDEM/MCT
Subject	*"Comparative Analysis of Asian Drivers and Western Capital Goods: A Case of the Garments and Textiles Sector in Uganda."*
Ref	HREC/2012/#1223/ Botchie /1
Red form	
Submitted	27 June 2012
Date	27 June 2012

Memorandum

This memorandum is to confirm that the research protocol for the above-named research project, as submitted for ethics review, is approved by the Open University Human Research Ethics Committee by **Chair's action.**

You should make sure that the participants are able to retain a copy of the information part of the consent form and that you avoid use of abbreviations and jargon. All electronic files and audio digital recordings should be kept on a secure computer and any backup should also be on an encrypted removable device such as a pen drive or hard disk. Before you start your data collection you should forward a copy of any structured questionnaires for our files.

Please make sure that any question(s) relating to your application and approval are sent to Research-REC-Review@open.ac.uk quoting the HREC reference number **HREC/2012/#1223/ Botchie /1**. We will endeavour to respond as quickly as possible so that your research is not delayed in any way.

At the conclusion of your project, by the date that you stated in your application, the Committee would like to receive a summary report on the progress of this project, any ethical issues that have arisen and how they have been dealt with.

Regards,

Duncan Banks

Dr Duncan Banks
Chair OU HREC

The Open University is incorporated by Royal Charter (number RC 000391), an exempt charity in England & Wales and a charity registered in Scotland (number SC 038302)

HREC_2012-#1223-Botchie-1-approval-chairs-action

Appendix VI: Consent form

My name is David Botchie; a PhD Research Fellow at The Open University, United Kingdom and currently attached to the Economic Policy Research Centre (EPRC), University of Makerere as a Research Associate. I am collecting data for my PhD studies in the garment and textiles sub-sector in Uganda. The study aims at unearthing the distinctiveness and profitability of garment making machines from the Asian Drivers relative to those from the Western economies. It also intends to analyse the extent to which Asian Driver garment making machines affect the distribution of income and thus contribute to poverty reduction in Uganda. I wish to seek your consent to conduct an interview with you on this research work. This interview will take some few minutes to complete. Your responses will be completely confidential and only be used for academic purposes only. Your participation in this study is absolutely voluntary. If you have questions, I will be happy to answer them now or at any point in the survey. If you have questions about the study or your participation after we have completed today's session, you can contact my supervisors at The Open University using the following email address: r.kaplinsky@open.ac.uk or r.e.hanlin@open.ac.uk. If you are satisfied and would like to continue with the interview, then please endorse the form below:

Name of respondent...................

Organisation of respondent.........

Position of respondent.................

Contact number of respondent............

Location of respondent................

Signature of respondent...............

Appendix VII: Benefit cost analysis for using WSMs in urban areas (US $)

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days Required	Labour Cost per Day	Total annual cost of Fabric	Repair Cost	Maintenance Cost	Energy Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	928.57	0	0	0	0	0	0	0	0	3.57	0.00	932.14	932.14	0	0	0	0	932.14	1
1		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	14412	15.71	**10**	33942.86	30913	16,501.00	0.911
2		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	13126	15.71	**10**	33942.86	28154	15,028.23	0.829
3		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	11954	15.71	**10**	33942.86	25641	13,686.91	0.755
4		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	10887	15.71	**10**	33942.86	23353	12,465.31	0.688
5		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	9916	15.71	**10**	33942.86	21268	11,352.74	0.627
6		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	9031	15.71	**10**	33942.86	19370	10,339.47	0.571
7		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	8225	15.71	**10**	33942.86	17641	9,416.64	0.520
8		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	7491	15.71	**10**	33942.86	16067	8,576.18	0.473
9		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	6822	15.71	**10**	33942.86	14633	7,810.73	0.431
10		30	2.32	216	2.19	15042.86	18.57	11.43	25.71	3.57	472.11	**15824.76**	6213	15.71	**10**	33,943	13327	7,113.59	0.393
												159179.79	99010			305485.71	210368	111,359	
																	NPV	111,359	
																	B/C	1.12	

Appendix VIII: Benefit cost analysis for using ADSMs in urban areas (US $)

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days	Labour Cost per day	Total annual cost of Fabric	Repair Cost	Maintenance Cost	Energy Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	642.85	0	0	0	0	0	0	0	0	3.57	0	646.43	646.43	0	0	0	0	-646.43	1
1		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	11320.48	14.64	8	25302.86	23044.50	11724.02	0.911
2		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	10310.09	14.64	8	25302.86	20987.70	10677.61	0.829
3		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	9389.88	14.64	8	25302.86	19114.48	9724.60	0.755
4		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	8551.81	14.64	8	25302.86	17408.45	8856.65	0.688
5		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	7788.53	14.64	8	25302.86	15854.69	8066.16	0.627
6		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	7093.38	14.64	8	25302.86	14439.61	7346.23	0.571
7		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	6460.27	14.64	8	25302.86	13150.83	6690.56	0.520
8		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	5883.67	14.64	8	25302.86	11977.08	6093.40	0.473
9		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	5358.54	14.64	8	25302.86	10908.08	5549.55	0.431
10		24	2.3	216	1.64	12034.29	14.62	6.57	15.99	3.57	354.86	12429.89	4880.27	14.64	8	25302.86	9934.50	5054.23	0.393
											124945.31	77683.35				227725.73	156819.94	79,136.59	
															NPV	79,136.59			
															NPV/Discounted Cost	1.02			

Appendix IX: Benefit cost analysis for using ADSMs in rural areas (US $)

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days Required	Labour Cost	Total annual cost of Fabric	Repair Cost	Maintenance Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	357.14	0	0	0	0	0	0	0	10.71	0	367.9	367.86	0	0	0	0	-367.86	1
1	0	12	2.32	216	1.16	6,017	24.98	12.48	10.71	249.94	6315.26	5751.60	15	4	12960	11803.27	6051.68	0.911
2	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	5238.25	15	4	12960	10749.79	5511.54	0.829
3	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	4770.72	15	4	12960	9790.34	5019.62	0.755
4	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	4344.92	15	4	12960	8916.52	4571.60	0.688
5	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	3957.12	15	4	12960	8120.69	4163.57	0.627
6	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	3603.94	15	4	12960	7395.89	3791.96	0.571
7	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	3282.27	15	4	12960	6735.79	3453.52	0.520
8	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	2989.32	15	4	12960	6134.60	3145.28	0.473
9	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	2722.51	15	4	12960	5587.06	2864.55	0.431
10	0	12	2.32	216	1.16	6017.14	24.98	12.48	10.71	249.94	6315.26	2479.52	15	4	12960	5088.40	2608.88	0.393
											63520.46	39508.05			**116640**	80322.40	40814.353	
															NPV		40,814.35	
															NPV/Discounted Cost		**£1.03**	

Appendix X: Benefit cost analysis for using WSMs in rural areas (US $)

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days Required	Labour Cost per day	Total annual cost of Fabric	Repair Cost	Maintenance Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	571.43	0	0	0	0	0	0	0	25	0	596.428571	596.4285714	15	3	0	0	-596.4285714	1
1	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	5835.95791	15	3	9720	8852.459016	3016.501106	0.911
2	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	5315.080064	15	3	9720	8062.348831	2747.268767	0.829
3	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	4840.692226	15	3	9720	7342.758498	2502.066272	0.755
4	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	4408.645015	15	3	9720	6687.393896	2278.748882	0.688
5	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	4015.159394	15	3	9720	6090.522674	2075.36328	0.627
6	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	3656.793619	15	3	9720	5546.924111	1890.130492	0.571
7	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	3330.413132	15	3	9720	5051.843453	1721.430321	0.520
8	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	3033.163144	15	3	9720	4600.950321	1567.787177	0.473
9	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	2762.443665	15	3	9720	4190.300839	1427.857174	0.431
10	0	12	2.32	216	1.53	6017.142857	23.8728571	11.6946429	25	330.17	6407.88179	2515.886762	15	3	9720	3816.303132	1300.41637	0.393
											64675.2464	40310.6635			97200	60241.80477	19931.14127	
															CBR		0.49	
															NPV		£19,931.14	

Appendix XI: Benefit cost analysis for the industrial WSMS

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days Required	Labour Cost per day	Total annual cost of Fabric	Repair and maintenance Cost	Energy Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	1,964	0	0	0	0	0	0	0	3.57	0	1967.857	1967.86	0	0	0	0	-1967.86	1
1		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	24111.37	17.86	17	58,285.71	53083.53	28972.16	0.911
2		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	21959.35	17.86	17	58285.71	48345.65	26386.30	0.829
3		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	19999.41	17.86	17	58285.71	44030.65	24031.24	0.755
4		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	18214.40	17.86	17	58285.71	40100.77	21886.37	0.688
5		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	16588.71	17.86	17	58285.71	36521.65	19932.95	0.627
6		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	15108.11	17.86	17	58285.71	33261.98	18153.87	0.571
7		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	13759.67	17.86	17	58285.71	30293.24	16533.58	0.520
8		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	12531.57	17.86	17	58285.71	27589.47	15057.90	0.473
9		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	11413.09	17.86	17	58285.71	25127.02	13713.94	0.431
10		54	2.5	192	2.14	25920	107.14	32.14	3.57	411.42	26474.29	10394.43	17.86	17	58285.71	22884.36	12489.92	0.393
											266710.7	166047.98			524571.43	361238.34	195,190.36	
																NPV	£195,190	
																NPV/Discounted Cost	1.18	

APPENDIX XII: Benefit cost analysis for the industrial ADSMS

Year	Capital Cost	Daily length of Fabric (yards)	Cost of Fabric per yard	Annual Man-days Required	Labour Cost per day	Total annual cost of Fabric	Repair and maintenance Cost	Energy Cost	Transport Cost	Labour Cost	Total Cost	PV of Cost	Selling Price of Garment	Quantity of Garment per day	Annual Gross Revenue	PV of Revenue	Cash flow	Discount Factor
0	1,071	0	0	0	0	0	0	0	3.57	0	1075	1075.00	0	0	0	0	-1075.00	1
1		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	24102.59	16.07	14	43200	39344.26	15241.67	0.911
2		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	21951.36	16.07	14	43200	35832.66	13881.31	0.829
3		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	19992.13	16.07	14	43200	32634.48	12642.35	0.755
4		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	18207.77	16.07	14	43200	29721.75	11513.98	0.688
5		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	16582.67	16.07	14	43200	27068.99	10486.32	0.627
6		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	15102.61	16.07	14	43200	24653.00	9550.39	0.571
7		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	13754.65	16.07	14	43200	22452.64	8697.98	0.520
8		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	12527.01	16.07	14	43200	20448.67	7921.66	0.473
9		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	11408.93	16.07	14	43200	18623.56	7214.63	0.431
10		54	2.5	192	1.79	25920	171.43	26.79	3.57	342.86	26464.64	10390.65	16.07	14	43200	16961.35	6570.70	0.393
											265721.43	165095.35			388800	267741.35	102,646.00	
															NPV	102,646		
															NPV/Discounted Cost	1.00		